ANNUAL REPORT
of the
DIRECTOR OF GARDENS, S.S.
for the year 1940

Staff

Mr. E.J.H. Corner, Asst.Director, acted as Food Supply Officer, Singapore, instead of his normal duties until June 30th. Mr.M.R. Henderson, Curator of the Herbarium, was on leave from Jan. 3rd to Aug. 28th. Mr. J.W. Ewart was seconded for service in the Food Supply Office throughout the year, Mr. J.C. Nauen, Asst. Curator, Penang, assisted the Food Supply Officer, Penang, during part of the year. All European Officers with the exception of the Director undertook discontinuous and continuous military training. Two Student Gardeners, under a new scheme for the training of locally recruited personnel for more responsible posts in the Department, started work on Jan. 1st, 1940.

Labour

The Labour force remained approximately as in 1939. Basic wage rates remained the same, and the additional cost of living allowances fixed by the Government were paid. Health was satisfactory in Singapore, but in Penang there were a number of cases of malaria, following four years with few or no cases. A hookworm survey was conducted in Singapore and treatment for sufferers arranged. Labourers were encouraged to plant ground round their quarters with vegetables.

Revenue

The revenue for the sale of plants seeds, etc. was as follows:

Singapore

Sale of plants and seeds	$2,442-01
Inspection fees etc.	412-48
Municipal contributions for Asst. Curator's services ...	2,400-00

Penang

Sale of plants & seeds	..	$ 758-63
Sale of Guides	..	7-50
Municipal contributions for Asst.Curator's services	..	1,200-00

Plant Collection & Field Excursions

Owing to the absence of most senior members of the staff during a considerable part of the year the amount of botanical field work undertaken was small. The Plant-Collector, Kiah bin Haji Salleh, went to Malacca in April to attempt to find Citrus malaccensis, an interesting tree only once found, near Nyalas, some 50 years ago. Kiah found the species, which has been re-named Burkillanthus malaccensis by Dr. W.T.Swingle of the U.S. Department of Agriculture. On account of the curious structure of the fruit, Dr. Swingle makes this species the type of a new genus. It is thought that it may be a useful stock for the grafting of other Citrus variaties in the tropics and an attempt is being made to secure viable seeds. Mr. Corner took leave at Fraser's Hill in July and made some collections; he also visited Johore on several occasions during the latter part of the year, and made regular collections in the Singapore Forest Reserves, with the aid of the Berok collecting-monkeys.

Botanical Reserves

The three Botanical Reserves in Singapore were maintained as in 1938 and 1939. Quarters for the labourers patrolling Bukit Timah and Kranji Reserves were erected near the entrance to the former. A good water supply is available from the neighbouring valley by the use of a hydraulic ram. A considerable number of further trees have been identified and labelled at Bukit Timah, and a few new paths made. Timber thefts were slight, and the areas formerly felled are growing up satisfactorily. A number of native Malayan trees were planted.

Herbarium Work and Other Investigations

Dr. C.X. Furtado was working in the herbarium throughout the year. He continued his study of the cultivated aroids, and made progress in clearing up some of the confusions of nomenclature which have made this group such a difficult one. Planting material was obtained from the Royal Botanic Gardens, Calcutta, and from the Department of Agriculture of the N.E.I. The plants raised from this material helped considerably in understanding the position, and we are grateful to the authorities concerned for sending them. Dr. Furtado prepared a preliminary paper on these genera for the M.A.H.A. Magazine. He also made other studies of local vegetables, including the Chinese Brassicas grown in Singapore. He identified a number of green vegetables reported upon in a pamphlet by J.L. Rosedale and J.N. Milsum published by the Department of Agriculture. Dr. Furtado also spent some time in working on the palm genus Licuala, which is particularly well represented in Malaya, and prepared a paper on the subject, describing nine new species and re-describing the sections of the genus.

Mr. M.R. Henderson, on his return from leave, undertook the determination of the considerable accumulated collections on hand in the herbarium, retaining doubtful or specially interesting material for further study. Mr. Henderson also continued his work on the genus Eugenia.

Mr. E.J.H. Corner resumed his work on fungi, which was put aside for a time during the preparations of his book "Wayside Trees of Malaya", which is mentioned under the heading publications below. Mr. Corner is preparing notes and illustrations on a very large number of local fungi.

Mr. R.E. Holttum completed a study of the fern genus Diplazium, which is extensively represented in the shady forests of Malaya,

and prepared a paper on the group. Mr.Holttum also prepared for publication an account of his observations on the periodic behaviour of trees in Singapore, and continued his work on hybrid orchids.

Duplicate herbarium specimens were not distributed in such large numbers as in normal years. The following were despatched as exchanges:-

To The Botanic Gardens, Buitenzorg, Java	391
The Arnold Arboretum, U.S.A.	235
The Forest Research Inst., Kepong	302
The Philippine National Herbarium	120
The Economic Botanist, Mandalay (grasses)	53
Total	1101

The following specimens were received as exchanges:-

From The Arnold Arboretum, U.S.A. ..	262
The Conservator of Forests, B.N. Borneo ..	145
The Philippine National Herbarium	125
Total	532

Herbarium specimens were lent for purposes of study as follows:-

To The Forest Research Institute, Kepong (Dipterocarpaceae) ..	273
Prof. S.P. Agharkar, Calcutta, (Mangifera) ..	322
Dr. C.G.G.J. van Steenis, Buitenzorg ..	29
Dr. E.D. Merrill, Harvard (Olacaceae) ..	44
Mr. Gordon Spare (Utricularia) ..	17
Total	685

The number of sheets of herbarium specimens mounted during the year was:-

Local collections ...	3172
Gardens herbarium ...	592
Exchange collections ..	3735
Total	7499

Publications

Mr. Corner's book "Wayside Trees of Malaya" in two volumes (text 770 pages, and 228 plates) was published by the Government Printing Office in June. The progress of work on this book, which has taken several years, has been mentioned in previous reports from 1935 onwards. It is an entirely original work, covering some 950 species of native and introduced trees and tall shrubs, including all such as are to be found outside the primitive high forest of Malaya. An introductory section gives sufficient general botanical information for the novice, and the extensive keys are all based on easily observed field characters. A valuable feature of the work is the comparative accounts (illustrated with line drawings) of the fruits of such groups as the oaks, allies of the Mangosteen, and the wild figs, none of which have previously been adequately treated. The book will be of very great value in Malayan schools and to amateur naturalists; it should also be of interest to students in other parts of the tropics, as it covers many trees which are widely planted.

Volume XI, part 2, of the Gardens' Bulletin, S.S., was published on Nov.29th. This contained a paper on the palm genus Licuala in Malaya by Dr. C.X. Furtado, a paper on the Fern genus Diplazium in Malaya by Mr. R.E. Holttum (both papers giving a complete survey of the species, with key, descriptions and illustrations) and a paper on the periodic behaviour of trees in Singapore by Mr. R.E. Holttum (summarizing ten years' observations).

The M.A.H.A. Magazine appeared regularly each quarter, the horticultural material chiefly contributed by the staff of the Gardens Department. Several papers on vegetables were included.

A small pamphlet on local vegetable cultivation was prepared at the request of

the Department of Information. The pamphlet was several times reprinted and proved useful pending the publication of a fuller work on the subject.

The Malayan Orchid Review, Vol. 3, pt.1 appeared in April and contained a number of accounts of new hybrids raised in the Singapore Gardens by Mr. Holttum.

Plants Outwards and Inwards

The local demand for plants remained about normal in Singapore, and increased at Penang, thus involving additional work in propagating yard and nursery. Exchanges of seeds with other botanical institutions were much reduced owing to war conditions, especially after the early part of the year.

Gifts of plants and seeds from the following are gratefully acknowledged. Singapore: Department of Agriculture, N.E.I.; Director of Agriculture, Seychelles; Mr.Tan Chye Siam, Mr. J.M. Jackson, Mr. E.F. Allen, Mr. Claude de Silva, Mr. E.E.H. Beck, Mr.H. Schweizer, Mrs. Alexander. Penang: H.H. Tungku Yacob, Mrs. G.S. Reis, Mr. Heah Seng Whatt, Mr. J.A. Carrier, Mr. G. Martin, Mr. K.B. Eyre, Mr. P.C.B. Newington, Mrs. H.C.D'Arcy-Irving, Mrs. H.T.W. Oswell, Mrs. G. Aste, Dr. K. Muttukumaru, Mr. E.F. Allen.

Seeds and plants were received on an exchange basis from the following institutions: University of Catania, Bureau of Plant Industry, Manila; Botanic Gardens, Montevideo; Canal Zone Experimental Garden, Panama; Botanic Gardens, Buitenzorg; Royal Agri-Horticultural Society of India; Taihoku Botanic Gardens; Botanic Gardens, Basel; Royal Botanic Gardens, Calcutta; Botanic Gardens, Coimbra; Forest Botanist, Dehra Dun; U.S. Plant Introduction Garden, Coconut Grove, Florida; Botanic Gardens,

Brisbane; University Botanic Gardens, Goteborg, Sweden; Director of Parks, Durban; National Botanic Garden, Kirstenbosch, Cape; Botanic Garden, St. Andrew's; Royal Botanic Gardens, Glasnevin; Central Experiment Farm, Ottawa; Botanic Gardens, Sydney; La Mortola, Italy; Harvard University Experiment Station, Soledad, Cuba; Department of Agriculture, Rabaul, New Guinea.

Seeds were despatched to 43 botanical and agriculture institutions in other countries.

Plants Outwards:

Singapore	Plants sold	...	6923
	Cuttings etc. sold	...	7469
	Seeds sold (packets)	...	50
	Plants supplied free or on exchange	...	5141
	Cuttings etc. - do -	...	1531
	Seeds on exchange (packets)		207
Penang	Plants sold	...	2679
	Cuttings etc. sold	...	2821
	Seeds sold (packets)	...	44
	Plants supplied free or on exchange	...	9533
	Cuttings etc. -do-	...	17433
	Seeds on exchange (packets)		26

Plants Inwards:

Singapore	Plants	...	253
	Cuttings etc.	...	157
	Seeds (packets) on exchange		367
	Seeds (packets) purchased		233
Penang	Plants	...	804
	Cuttings etc.	...	192
	Seeds (packets)	...	376

The Botanic Gardens, Singapore

Work continued in the Gardens as usual, no major changes being made. A considerable

number of new trees and shrubs were planted out. The lake continued to give a remarkably fine display of Nymphaeas, especially the N. lotus hybrids, throughout the year.

Vegetable Culture This was continued as in the latter part of 1939. The demonstration plot on lawn R was maintained, and evoked considerable public interest. Part of the Canna nursery was devoted to the culture of the numerous kinds of Colocasia, Xanthosoma and Alocasia which were under observation by Dr. Furtado.

Orchids The collection of hybrids continued to develop well, and a continually increasing display of plants in flower was on show in the plant house. Towards the latter part of the year the small plant house was re-arranged, and the roof cleared of climbers. This provided much more satisfactory conditions for display of the flowering orchids, which lasted longer and were maintained in better condition. As many as 80 hybrid seedlings in flower simultaneously were on show towards the end of the year. The number of second generation seedlings to flower increased, including several of the cross Vanda Miss Joaquim x tricolor which proved very varied.

Rhododendrons The seedlings of Rhododendrons longiflorum mentioned in the report for 1939 continued to grow well, and had almost reached flowering size by the end of the year. They are certainly hybrids, in some of which the species R. jasminiflorum predominates.

The Waterfall Gardens, Penang

Under the care of Mr. J.C. Nauen, excellent progress was made in the Waterfall Gardens during the year, in spite of the very severe dry weather in January - March.

The total rainfall for January and February was only .54 inch, all of which fell on three days; the rainfall for March was 2.51 inches.

Government House Domain & Other Outside Gardens

Singapore:

Government House Domain The new developments carried out in 1938 and 1939 were consolidated and maintained, but no further major changes were made. The vegetable gardens were extended. Numerous new trees and shrubs were planted near the border adjacent to the filter beds. A few old tembusu trees which were dying back were removed.

Municipality More than 1000 new trees were planted, 500 of these being in Braddell Road and Bartley Road. Species not previously used in Singapore as roadside trees were: Sepium jamaicense, Lagerstroemia floribunda, Millettia atropurpurea, Gliricidia sepium. The Tamarind trees planted in Still Road in 1939 had to be removed owing to defence works; trees of this species were later planted in Bartley Road. In Jubilee Park some 500 new trees and shrubs were planted, and previous planting made good progress. At Farrer Park nearly 200 new trees were planted to replace old ones which had not made satisfactory growth. At Katong Park 6 Tamarind trees were planted and a few old Terminalia trees removed. Mr. G.H. Addison had charge of Municipal work, as well as work in Government House Domain, throughout the year.

Penang:

The Residency grounds were maintained as usual. The long herbaceous border was completely replanted and re-arranged, numerous

plants being added. At Bel Retiro most of the borders were replanted and several additional groups of shrubs established. At the Crag Hotel a number of Podocarpus trees and Juniperus chinensis were planted to replace dead Cypresses and other trees. The Podocarpus Rumphiana and P.usambarensis planted last year have made very good progress. Various new ornamental plants were tried on the hill, the best being Lobelia erinus (tall type), Ageratum dwarf blue, a hybrid Russellia and a deep red-flowered perennial Phlox. The gardens of the other hill bungalows, and in the vegetable garden, continued as usual. Some good cauliflowers were raised on the hill.

T H E

G A R D E N S' B U L L E T I N .

S I N G A P O R E

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THE SINGAPORE BOTANIC GARDENS DURING 1941-46

Prior to the Japanese attack on Malaya, most of the senior staff of the Gardens were seconded for other duties under the Departments of Food Control and Information, for at least part of the time. The result was that botanical work was reduced, and considerable arrears of unnamed and undistributed specimens accumulated. The Gardens were maintained as usual, with the addition of demonstration plots of vegetables.

After the attack on Malaya, Messrs. J. C. Nauen (in charge of the Waterfall Gardens, Penang) and G.H. Addison, horticultural officers, were mobilized with the local defence forces; they were subsequently taken prisoner and sent to work on the Siam-Burma railway, where Mr. Nauen lost his life. An appreciation of Mr. Nauen's services is given elsewhere in this issue. Mr. J.L. Pestana, Laboratory Assistant, was similarly taken prisoner and sent to Siam. Mr. J. W. Ewart, the third senior horticultural officer, was on leave, and was later transferred temporarily to the Dept. of Agriculture, Gold Coast. Mr. M.R. Henderson, Curator of the Herbarium, was evacuated from Singapore with the Dept. of Information, and subsequently worked in the herbarium of the National Botanic Gardens, Kirstenbosch, South Africa. Messrs. R.E. Holttum and E.J.H. Corner remained in Singapore during the Japanese occupation; also Dr. C.X. Furtado, Assistant Botanist.

At the time of the Japanese attack on Singapore, fighting ceased on a line about

half a mile from the Gardens boundary. Part of the Gardens was occupied by defending troops, and a considerable number of small shells were fired by the Japanese into the Gardens. Most of these exploded in tree-tops, and caused some casualties later among the trees. A few small trees were damaged owing to the digging of trenches and other operations, but on the whole the woody plants of the Gardens suffered little serious damage. The Director's house had a direct hit from a shell, and the Gardens Store was slightly damaged by a bomb which exploded 20 yards away. The offices and herbarium were undamaged. The local Gardens staff nearly all remained at their quarters, where they had good shelters; three or four of them suffered minor injuries.

Three days after the Japanese occupation, Professor Hidezo Tanakadate, of Tohoku Imperial University, assumed control of the Gardens. He asked Mr. Holttum to remain in executive charge, and to resume all normal horticultural work. The Japanese military required the supply of some ornamental plants, but only such as were easily propagated. Professor Tanakadate and his successors took energetic steps to see that the Gardens were not in any way despoiled by the Japanese military; and the same action was also taken with regard to the Nature Reserves in Singapore Island under the control of the Gardens. Prof. Tanakadate arranged for the Botanic Gardens and Raffles Museum to form a single Department under the Municipality of Singapore, with head office at the Museum. In Sept. 1942 the Marquis Yoshichika Tokugawa assumed the office of Honorary President of the Museum and Gardens; this he held until his departure for Japan in the middle of 1944.

In December 1942 Professor Kwan Koriba, Professor of Botany at the Imperial University of Kyoto, was appointed Director of the Gardens. Thereafter Mr. Holttum ceased to have responsibility for garden work, but unofficially both he and Mr. Corner remained in constant touch with the local

staff and advised them in their work. Garden work continued throughout the Japanese occupation, but greatly deteriorated for various reasons. More than half the out door staff (49 men) were sent by the Japanese military to work in the Siam-Burma railway; some of those remaining were taken for planting experimental crops of medicinal, fibre and dye plants in the adjoining Tyersall estate, and latterly all spent part of their working time in food production; tools also were gradually reduced both in number and quality. Fortunately the motor mowers were maintained in good running order throughout, so that the grass of the main lawns never got out of hand. Many outlying parts of the Gardens were neglected and became overgrown, and there were considerable losses in some collections of smaller plants. Stocks of pot plants were greatly reduced.

Wages for local staff at the end of the Japanese occupation were less than double the wages of 1941, but prices gradually increased to about 500 times those of 1941, with the exception of a small and diminishing fixed-price ration of rice, sugar and oil. Municipal employees, including those of the Gardens, were at a great disadvantage as compared with persons employed directly by the Japanese military; but most of the Gardens staff, both indoor and outdoor, remained at their work. Had they not done so, the Gardens could not have been maintained as they were, nor so quickly rehabilitated in 1946. In this connection, special credit is due to Mr. Quan Ah Gun, Chief Clerk, and to Dr. Furtado. Of the men who were sent to work on the Siam-Burma railway, twenty-two lost their lives. These included both Indians and Malays.

Prof. Koriba obtained permission for Messrs. Holttum and Corner to remain in the Gardens and continue their botanical

work. Mr. Corner continued his researches on the larger fungi, and also made elaborate investigations of the development of flowers and fruits in various families of trees, from the appearance of the first floral rudiments to ripe fruits and seeds. Mr.Holttum spent most of his time preparing new descriptions of Malay Peninsula representatives of the following groups: Ferns, Orchidaceae, Zingiberaceae, Marantaceae, Gramineae, Cyperaceae.

The Herbarium remained intact (except for the loss of some specimens on loan in Germany) and also the library. All the Japanese scientific officers concerned were insistent that the Herbarium and Library (as also the collections at the Raffles Museum) should be preserved as part of the cultural heritage of Malaya, and on this basis the British staff cooperated with them. We should like to express our gratitude to Professor Koriba and others concerned for the disinterested way in which they carried out their duties, and also for much personal courtesy and kindliness. Professor Koriba himself carried out a research into the growth-behaviour of some Malayan trees.

From September 1945 to March 1946, under the British Military Administration, the Gardens were under the care of Dr. Gilbert Archey (Director of the Auckland Museum, New Zealand), who was responsible for Monuments, Fine Arts and Archives. Mr. Holttum left for England on September 18th. Mr. Corner remained in Singapore in immediate charge of the Gardens until November 11th. Mr. J.W.Ewart returned soon afterwards and had charge of the Gardens until the return of Mr. M.R. Henderson in January 1946. Mr. Addison returned to take charge of horticultural work in April 1946, Mr. Ewart being appointed to undertake the duties of Agricultural Officer, Singapore. Mr. Holttum returned to duty as Director in May 1946.

MR. J.C. NAUEN

John Charles Nauen came to Singapore in July 1935 as an Assistant Curator of the Gardens. He had previously served seven years in Bermuda after completing his training as a Student Gardener at Kew. He remained in Singapore until July 1939, when he was placed in charge of the Waterfall Gardens, Penang. When the Japanese attacked Malaya in December 1941, Mr. Nauen was mobilized as Sergeant in the Penang Volunteer Force, and as such was taken prisoner in Singapore in February 1942. He was subsequently sent to work on the Siam-Burma railway, where he died as a result of blood poisoning in October 1943.

Mr. Nauen was an officer of outstanding ability; and as a man he was held in affection and esteem by all who knew him. He had a very wide knowledge of garden plants and their management, excellent judgement in their use and arrangement, and a great gift in garden design. He devoted much thought to his administrative work and to the welfare and training of those who worked under him. He helped considerably to raise the standard of horticultural work in the Gardens both at Singapore and Penang. He devoted much time and thought to the roadside trees of Singapore. He helped to found a Gardening Society in Singapore, and did good service as its first Secretary. He was the leading spirit in the organization of the Society's Flower Shows, which were a stimulus to professional and amateur growers alike. His alert mind, his sense of humour, his human sympathy, and his integrity of purpose are the characters by which we remember him. His untimely death is a great loss to Malaya.

COLONY OF SINGAPORE

BOTANIC GARDENS DEPARTMENT ANNUAL REPORT FOR 1948

BY

R. E. HOLTTUM, M.A., F.L.S.,
Director of Gardens, Singapore.

Introductory.

Shortly after the founding of Singapore, Raffles established a Botanic Garden on the slopes of Fort Canning, towards Stamford Road, but this Garden was abandoned in 1829. The present Botanic Gardens date from 1859, and were started by an Agri-horticultural Society formed for the purpose. The Socicty continued to maintain the Gardens until 1874, when they were handed over to the Government.

Until the formation of the Malayan Departments of Forestry and Agriculture at Kuala Lumpur about 1905, the Singapore Botanic Gardens was the only centre of research on Forestry and Agriculture in Malaya, and there were subsidiary stations at Penang and Malacca. The Superintendent of the Gardens made the first report on the Forests of the Straits Settlements in 1882, as a result of which Forest Reserves were established under his control. The Economic Garden, established in 1879 on land adjacent to the Botanic Gardens and now occupied by Raffles College, was used for experimental planting of many newly introduced useful plants, among them the first Para rubber trees, brought to Singapore in 1878. The early tapping experiments were carried out in the Economic Garden under Mr. H. N. Ridley, and from the trees in the Economic Garden seeds were supplied for planting many rubber estates in Malaya.

Along with this pioneer work of immediate economic importance, the Botanic Gardens has throughout been a centre for the study of the native Flora of Malaya. Botanical exploration began in the eighteen seventies, and has resulted in the formation of a very large collection of herbarium specimens (mainly dried) and drawings. Many local species have also been cultivated in the Gardens and studied in the living state. Along with the building up of a herbarium, a botanical library has also been gradually established, containing most of the important books and periodicals dealing with the plants of S. E. Asia. Based on this material, Mr. H. N. Ridley prepared a Flora of the Malay Peninsula, published 1922-25.

In recent years the Botanic Gardens have been concerned with the more decorative side of horticulture, experimental introduction of new plants, with plant breeding, and with a continued study of the Malayan Flora. These are all interdependent activities. Fortunately our herbarium and library survived the war intact. The Botanic Gardens also has control of three areas of natural vegetation in Singapore island which are maintained as Nature Reserves.

Botanical Work in 1948.

The principal object of the botanical work of the Department is the preparation of a revised Flora of the Malay Peninsula. Mr. Ridley's Flora, published 1922-25, is now much out of date, and is also difficult to understand unless one has access to the Singapore herbarium on which it is based. That Flora contains descriptions of over 6,000 species of higher plants (not including ferns). Probably present collections will show an increase to about 7,000 but still every new collection of any size includes species not known to exist in Malaya previously, and our knowledge of many others is derived from single specimens only. It is thus impossible even now to prepare a complete account of the Flora; but it is possible to prepare an up-to-date account which is intelligible to the non-specialist, and this is our aim. To prepare such a Flora one must study also records and specimens of plants in neighbouring countries, as many of our species are not confined to Malaya; and it may be

desirable to prepare monographs of groups of allied species including some which occur outside Malaya. A Flora also should have illustrations, and these must be accurately drawn by a trained artist under expert supervision. All this work is complex and cannot be hurried; to complete it will take several years.

During the period of Japanese occupation, the Director studied several plant families and prepared new descriptions of all species in them. During the year 1948 the copying and revision of these manuscripts was completed. The families are: ferns, orchids, grasses, sedges (Cyperaceae) and gingers (Zingiberaceae). Every opportunity was taken to check the manuscript by examination of fresh specimens of plants of these families, and a few additions were made during 1948. It is hoped to keep these manuscripts up-to-date in this way pending the possibility of publication.

The Director also carried out further studies of bamboos, and made a preliminary study of the Pandans of Malaya. A short field expedition was made in February to Ulu Langat, Ginting Simpah, and the Cameron Highlands road, to study bamboos in the foot-hills of the main range, and some useful new data obtained. Much more field study of bamboos in the north of Malaya is necessary, as the number of kinds in the north is much greater than in the south, and the discrimination of allied species is often difficult. As regards Pandans, there are some forty species in Malaya, including several which have never been described, and the establishment of characters by which they can be distinguished when not flowering or fruiting needs more study. Some of them fruit rarely, and the male flowers of some are quite unknown.

Mr. M. R. Henderson, Assistant Director, was absent on leave from March to October, 1948. His work on the genus Eugenia in Malaya was sent to press and is to appear in the Gardens' Bulletin in 1949. Mr. Henderson made provisional revisions of the families Dilleniaceae and Magnoliaceae in Malaya, but as specialists were also engaged on these families for the larger area covered by *Flora Malesiana*, the manuscripts were sent on to these authors for use in connection with their work.

Mr. Henderson spent a considerable amount of time working on a popular book on Malayan Wild Flowers, illustrated with line drawings, which is being printed in parts in the Malayan Nature Journal. The work is an attempt to describe the commoner small plants of Malaya, for the benefit of the reader who is not a botanist and who wishes to know the names and relationships of the plants he may see in villages and at hill stations.

Mr. J. Sinclair, Curator of the herbarium, arrived to assume duty on 1st May, 1948. Mr. Sinclair immediately began a revision of the family Annonaceae for the Flora, and at the end of the year had nearly completed this work so far as present collections permit. He also carried on the usual routine work of the herbarium, identifying specimens from the Conservator of Forests in North Borneo, the Department of Agriculture, Kuala Lumpur, the Rubber Research Institute of Malaya, and other institutions and persons. Mr. Sinclair carried out a considerable amount of field work in Singapore island, collecting specimens for exchange purposes and also adding data for our own herbarium. Both coloured and line drawings were prepared by the artist of all Annonaceae found in flower and fruit in Singapore during this work.

Dr. C. X. Furtado, Assistant Botanist, continued his work on Malayan palms, and completed an account of the genus Calamus in Malaya (about 75 species). These include the great majority of the useful rattan canes of Malaya. Dr. Furtado also continued his study of the complex problems of botanical nomenclature and prepared a further paper on the subject.

The artist worked continuously throughout the year, making drawings in line and in colour of plants of both botanical and horticultural interest. Mrs. D. Kinloch Smith also presented to the Gardens a fine series of coloured drawings she has made from flowers cultivated in the Gardens.

The Herbarium.

Steady progress was made with mounting of specimens, and 4,452 sheets were added to the herbarium during the year. A total of 3,095 specimens were despatched on an exchange basis to herbaria at Leiden, Manila, Calcutta, Edinburgh, Lisbon and Paris. Receipts of specimens amounted to 3,486, from Paris, North Borneo (Forest Department), Leiden, Brisbane, Auckland, and Dehra Dun (Forest Research Institute). 524 specimens were sent on loan for study, chiefly in connection with the *Flora Malesiana* scheme, to Kew, the British Museum (Natural History), and Zurich.

The Hong Kong herbarium, which was sent to Penang for safe keeping in 1940, brought to Singapore by the Japanese, and then incorporated in the Singapore herbarium for greater safety, was returned intact to Hong Kong in 1948. In the meantime it had been useful for various studies in Singapore. The building in which it had been housed in Hong Kong was destroyed during the war.

Publications.

Vol. XI, part 4, of the *Gardens' Bulletin* was published in October, 1947. Material for further parts is ready but printing was not possible during 1948. The *Gardens' Bulletin* contains descriptions of new species and other detailed and critical matter not suitable for publication as part of a Flora; such publication is an essential preliminary to the preparation of more general works. The *Bulletin* is exchanged with similar publications from other botanical institutions and so is valauble in building the Gardens' library. The Director published a critical review of the Classification of the family Cyperaceae in *The Botanical Review* (New York).

As regards major publications, a reprint of Corner's *Wayside Trees of Malaya* is the most urgent necessity, as this work is very useful as a general introduction to the study of Malayan plants. It is hoped that reprints of *Wayside Trees* will be followed by publication of the works on orchids, ferns etc. which have now been prepared.

Roads, Buildings, Etc.

The main roads in the southern part of the Gardens were re-laid and surfaced by the Public Works Department, and the drains also renewed. The roads in the northern half remain to be dealt with. Traffic is at present restricted to the newly made roads, which allow plenty of space for parking of cars; this also leaves the other roads free for visitors to walk without interference from traffic. The number of visitors is now far greater than before the war, especially at week-ends.

The Public Works Department also removed a great deal of silt from the upper part of the lake, which was deepened to three feet. The resulting damage to the adjacent lawns and paths was not made good by the end of the year.

The plant houses for display of pot plants, orchids etc, have still not been rehabilitated. One house for propagating pot plants was re-roofed, and one temporary house for orchid seedlings built, but our requirements of roofed houses for protecting seedlings and young pot plants from torrential rains are still far short of our needs.

Horticultural Work: Botanic Gardens.

During the year the Botanic Gardens were brought back to about their pre-war standard of maintenance, and nursery stocks also were increased so that rooted plants of all the most useful kinds were available for sale to the public. In all 6,885 plants were sold, and the revenue obtained was $5,348.

The plans showing woody plants on the various lawns throughout the Gardens, and the card-index of these plants, were checked and kept up-to-date. Over 700 wooden or metal painted labels were made, and also a large quantity of tie-on aluminium labels.

Canna beds were re-made and planted all along the road from the main gate to the lake, restoring the pre-war appearance of this area. The beds were closed during the Japanese occupation owing to a disease which killed most of the Cannas.

The area containing the bamboo collection, which had become much overgrown, was thoroughly cleared and brought into a condition to be mown regularly. The bamboo collections were increased by addition of some new kinds brought in for study by the Director.

New trees and shrubs were planted in various places, but this work has not yet reached the extent it should attain. One reason is the great labour necessary for digging our heavy clay soil, and the large amount of compost needed, when new trees are planted.

The area on lawn R devoted to smaller plants of economic value (a vegetable garden during the war) has been fenced, and various plants have been added including Vanilla and Cocoa. It is intended to increase the collection in this area as opportunity offers.

Succulents. An effort has been made to increase the number of succulent plants. Some thirty different species of Cereus, Aloe, Gasteria and Haworthia were received as a gift from Kew, and other plants were raised from seeds from Kirstenbosch (Cape), the U.S.A., Cuba and Lisbon. Several of these flowered during the year, notably two very curious species of Stapelia (*S. variegata* and *S. Wilmaniae*) from South Africa. The larger cacti are in cultivation in a sun rockery on lawn E, and some have been added to this area during the year. A large old plant of *Cereus peruvianus* flowered and fruited several times, and a large number of seedlings were raised from it. Some of them were used as stocks for grafting the less wet-resistant kinds of Cereus, and it is hoped that the grafted plants will now stand cultivation in the open. Three such grafted plants have already been planted as a trial. A surprising range of succulents can be grown in Singapore if they are protected from heavy rain, suitably potted and given no more water than they need, but a good many will not flower in our humid atmosphere.

Pot plants. The display of flowering pot plants was maintained as in previous years. Some new varieties of Coleus were grown. The Hydrangeas were particularly good. The foliage pot plants in the plant house were also maintained, and there was considerable improvement in the standard of the Anthuriums. A few fine new Anthuriums were presented by the Bangkrabue nursery, Bangkok, and it is hoped to breed more new varieties from these by crossing.

Orchids. The experimental production of hybrid orchids was begun in a small way in 1930, and has continued since. The object of the work is to produce a variety of fine new orchids which will flower well in the lowland climate of Malaya, as few such orchids are provided by nature and by orchid breeders in other countries. The process is slow and has many difficulties.

Orchid seeds are small, and must be grown on agar-agar in sterile culture, and the step of transference of seedlings from culture flask to the open air is a critical one. During 1948 a considerable advance in this last matter was made,

A free-flowering hybrid orchid raised at the Botanic Gardens, Singapore: Aranda Hilda Galistan.

Casuarina trees on lawn C; *C. equisetifolia* on left (Malayan), *C. sumatrana* in centre, *C. glauca* on right (Australian).

Arachnis–Vanda hybrids raised from seed at Singapore.

Young seedling orchid plants; the pots are embedded in coir dust.

by the use of coir dust as a medium in which to plant the newly transferred small seedlings. Coir dust is light and holds a great deal of moisture without becoming sodden; it therefore maintains the constant moist conditions which the orchid seedlings need, and at the same time is well aerated. Furthermore, it is free from moulds, and rots very slowly. The pots of all small seedlings also are plunged into a deep bed of coir dust, which maintains a cool humid atmosphere all around; for this purpose it is probably better than a free water surface.

The kinds of orchids most useful for the lowlands of Malaya are the scorpion orchids (Arachnis), the Vandas (especially terete Vandas), the red-flowered Renantheras, Dendrobiums of the section Ceratobium from Eastern Malaysia, and the Malayan terrestrial genus Spathoglottis. Vanda, Arachnis and Renanthera are particularly useful because they are very easy to propagate and stand full sun; they may therefore be grown in any garden, only needing a supporting post with a good layer of compost around the base. The only wild orchid of this alliance which is really strong and free-flowering in Singapore is the white scorpion orchid, *Arachnis Hookeriana* (also called *A. alba*), but a number of hybrids produced from this, and also from terete Vandas, by crossing with a variety of related species, have proved very free-flowering. The intention is to increase the number of these, and many hundreds of new seedlings are now at various stages of development. It is necessary to raise a large number of seedlings to secure the maximum possible variation, and so increase the chance of producing a few really good novelties. For success, a plant must be strong, free-flowering, and have large flowers of good form and distinctive colour, and among hybrids of the second and third generation only a small minority may have all these desirable features.

The following free-flowering hybrids have now been produced, and are being propagated from cuttings:

Arachnis Maggie Oei (A. flos-aeris x A. Hookeriana var. luteola)
Arachnis Ishbel (A. Hookeriana x Maingayi)
Arachnis Catherine (A. Hookeriana var. luteola x Sulingi)
Aranda Deborah (A. Hookeriana x V. lamellata)
Aranda Hilda Galistan (A. Hookeriana x V. suavis)
Aranda Nancy (A. Hookeriana x V. Dearei)
Aranda Mei Ling (A. Hookeriana x V. sumatrana)
Vanda Cooperi var. Cho Yam Neo (V. Miss Joaquim x Hookeriana)
Vanda Mme. E. M. E. Dinger, a selected variety (V. Miss Joaquim x tricolor)
Vanda Amy (V. Hookeriana x tricuspidata)
Vanda Nam Kee (V. Cooperi x Marguerite Maron)
Aranthera Mohamed Haniff (Arachnis Hookeriana x Renanthera coccinea).

Pure white Vanda hybrids have been produced by the use of a white variety of *V. Hookeriana*, but the plants are not strong. A further crossing with a large white *V. teres* has been made.

Plants of the genus Dendrobium cannot be grown in beds like Vandas, are slower to propagate and require more careful handling. The flowers however are very beautiful and durable, and the hybrids are mostly stronger and more free-flowering in Singapore than their parents.

Good progress was made in methods of cultivation of Dendrobiums during the year. There is no doubt that, when the plants are properly established in pots, intensive manuring may be practised, and that plants so manured will attain a much larger size than without such treatment. Intensive manuring seems to have no deterrent effect on flowering. In other countries manuring of orchids has been considered unnecessary, but it is certainly necessary for best results in Malaya.

Spathoglottis hybrids have combined the characters of yellow-flowered mountain species and purple lowland species. First generation hybrids are almost sterile, but one second generation hybrid has proved fertile and a large number of seedlings were raised from seed planted in October 1946. The first of these flowered towards the end of 1948, and included one of outstanding merit, with a good head of entirely pale creamy yellow flowers.

Seed Exchange. A seed exchange list was printed during the year and distributed to all Botanic Gardens which have sent us their lists. As a result there have been very numerous requests for seeds, and 967 packets have been sent out, to Gardens in all parts of the world. Seeds received in exchange amounted to 272 packets.

Government House Domain, Singapore.

The main areas of grass were maintained in good order by the use of motor mowers. An Allen motor scythe was purchased and with this the areas of lallang have been kept under control; it is hoped to bring much of this ground into a condition to be cut by an ordinary motor mower. A Hibiscus hedge 75 yards long was planted to separate the upper and lower parts of the Domain.

Further flower beds were made in front of Government House, and a number of new trees and shrubs planted. The *Bauhinia kockiana* plant gave a particularly fine display of flowers from August to December (this is a native Malayan climber with orange flowers).

The nurseries for flowering pot plants, cut flowers, and vegetables were maintained. Pot plants were changed twice a week. Some good new varieties of Dahlia have been introduced.

Other Work Outside Botanic Gardens.

Advice was given to the Public Works Department on the planting of trees and hedges at the St. George's Road quarters. Advice was given regarding the trees in the compound of St. Andrew's Cathedral, a new planting scheme was prepared, and the work of removing old trees and making new planting holes was supervised. Advice was also given about planting of trees, shrubs etc, at Social Welfare Department centres, at the residence of the Admiral, at R.A.F. stations and elsewhere, also to many individuals who enquired personally at the Gardens Office. Contact was maintained with the Municipal Parks Department throughout the year and advice given from time to time as requested.

The Botanical Reserves.

In 1937 the Forest Reserves in Singapore island (largely mangrove) were considered to be no longer worth maintaining for their production of timber. Parts of three Reserves were then handed over to the Botanic Gardens Department for maintenance as representative areas of natural vegetation. The areas retained the status of Forest Reserves for purposes of administration, but they have since been in effect Nature Reserves, primarily maintained for their botanical interest.

The three areas are: (1) a small area of mangrove adjacent to the 14th mile on the Woodlands Road: (2) a larger area of mangrove between the Pandan and Jurong rivers: (3) Bukit Timah Forest Reserve.

The Woodlands Reserve was formerly cleared of all but quite young trees. These trees have grown well in the past ten years, and other regeneration has also been satisfactory. The interesting species *Pandanus Corneri* is well represented; it probably now occurs nowhere else in the island. Two men

patrol the Reserve, and have maintained a path all round it. The path is in part a raised bank, and includes plank bridges. Re-making of part of the path was completed during 1948.

The Pandan Reserve also was almost entirely cleared of large trees in 1937. The regeneration in the past ten years has been satisfactory, and the effect of some re-planting (from seed) made in 1939-40 is now apparent. The Reserve contains all the characteristic plants of mangrove, and also is big enough to give shelter to an interesting natural fauna. Our thanks are due to Mr. Choa Ho Ann, who has taken a considerable interest in the Reserve from its establishment, and to him the present satisfactory condition of the trees is largely due.

The Bukit Timah Reserve includes all the remaining forest on the upper slopes of the hill, which is the largest in Singapore island (567 ft.) except the slopes in the water catchment area which adjoins the Reserve. The total area now reserved is about 200 acres. It includes a fine sample of primitive forest, with a great variety of trees and smaller plants, some of which certainly do not now occur elsewhere in the island.

Before 1941 a number of paths were made in the Reserve, to give access to all parts of it, and also a boundary path. The Reserve is regularly patrolled, and cutting of timber is now negligible. Areas which had been devastated in 1936–37 have regenerated well and now carry dense thickets of young trees. The Japanese fortunately did not do much damage in the Reserve though they made some excavations on the summit and at another place. During 1948 the paths were brought back to their former condition and regularly maintained, four of the shelters were re-built, and new plans of the Reserve placed in each shelter and at the entrance.

The Reserve is threatened on three sides by granite quarries. It is hoped that a limit has now been set to the extent of these quarries, as any further extension will seriously damage this final remaining piece of natural forest in the island. Such an area of forest must be sufficiently large if it is to be self-regenerating, and also if it is to maintain a humid internal climate in which the lesser forest plants can flourish. Ferns and other delicate plants will disappear (some have probably already gone) if the area is further restricted.

COLONY OF SINGAPORE

BOTANIC GARDENS DEPARTMENT ANNUAL REPORT FOR 1949

By
M. R. HENDERSON,
Assistant Director of Botanic Gardens, Singapore,

Printed at the Government Printing Office, Singapore,
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1950

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INTRODUCTORY

THE history of the Botanic Gardens, Singapore, was briefly sketched in the 1948 report, and it is not necessary to repeat it here. It may, however, be of interest to recall that the present Gardens were established in 1859, and came under Government control in 1874. The first attempt to establish a Botanic Garden was made by Sir Stamford Raffles soon after the founding of Singapore, but this Garden, which was sited on the slopes of Fort Canning, was abandoned in 1829.

STAFF

The Director, Mr. R. E. Holttum, retired from Government service in September to take the Chair of Botany in the University of Malaya. Mr. Holttum joined the Department in 1922 as Assistant Director and became Director in 1925. In his new sphere of activities as Professor of Botany he will be in close contact with the Botanic Gardens, and this association, it is certain, will benefit both the University and the Gardens. Mr. M. R. Henderson, Assistant Director, acted as Director for the remainder of the year, and Mr. J. Sinclair, Curator of the Herbarium, as Assistant Director. Mr. J. W. Ewart, Assistant Curator, Gardens, who returned from leave in August, resumed duty as Agricultural Officer, Singapore, in addition to his own duties. Bajuri bin Sappan, formerly Storekeeper, was appointed Technical Assistant as from 1st October, 1949. Mohamed Nur bin Mohamed Ghous, Herbarium Assistant, was on pilgrimage leave from 16th June to 15th December, 1949.

The labour force averaged seventy-five in the Gardens and fifty-six in Government House Domain. Their health was good.

BOTANICAL WORK IN 1949

Work on the revision of the flora of Malaya proceeds steadily, but has been somewhat slowed down by the impossibility, or at least the inadvisability of undertaking field expeditions in the Federation. Those places which would be most profitable to visit seem also to be those most infested by bandits. The only collecting tour undertaken in the Federation was one to Maxwell's Hill, Taiping, by Mr. J. Sinclair in September. This is a *locus classicus* of Malayan botany, having been visited by many botanists during the past seventy or eighty years. But Mr. Sinclair found, as any botanist in Malaya will find who thoroughly explores even a small area of forest, that there is still something new to be recorded. Two ferns new to Malaya were found on Maxwell's Hill, as well as some other plants which had been previously known only from one collection from other localities. Mr. Sinclair, who has done a considerable amount of collecting in Singapore island during the year, demonstrated that even here, where the original vegetation of the area has almost disappeared, novelties can be discovered, and he has added a dozen or more plants to the flora of Singapore. Mr. Sinclair visited Kuching in February at the request of the Sarawak Government in order to examine and put into order the Herbarium of the Sarawak Museum, which had been neglected during the Japanese occupation, but which, fortunately, had suffered little damage during

that time. This Herbarium is a small one but it contains many important Bornean collections. During his visit Mr. Sinclair was enabled, through the courtesy of Mr. Tom Harrisson, Curator of the Sarawak Museum, to visit and make collections at Mount Santubong, Kampong Segu, the limestone hills near Bau, and at Buso.

Mr. M. R. Henderson began the study of the genus *Calophyllum* of the family Guttiferæ. This is a group of forest trees which are now providing a certain amount of commercial timber. They are, botanically, a difficult group, the Malayan species of which have never been properly understood. As a result their nomenclature is in confusion and must be straightened out as a preliminary to understanding what is available in the forest and what their distribution is. Mr. Henderson continued work on his popular account of the *Wild Flowers of Malaya*, the first part of which is now published.

Mr. Sinclair continued as far as possible with his revision of the *Annonaceæ*, but awaits material from Borneo and India which is being sent on loan from Kew and Dehra Dun. Loan material of this family has been sent by the Department of Agriculture, Thailand, and by the Sarawak Museum, and Mr. Sinclair took the opportunity, while on leave in India, to consult type material in the Herbarium of the Royal Botanic Gardens, Calcutta.

Dr. C. X. Furtado pursued his studies of several genera of palms and completed manuscript revisions of the genera Korthalsia, Plectocomia and Plectocomiopsis.

The artist was kept fully employed during the year, executing mostly line drawings for the illustration of various botanical manuscripts, and also coloured drawings of new hybrid orchids and other plants. Mrs. Kinloch Smith presented a further series of water colour drawings of plants cultivated in the Gardens. These are of outstanding merit, both technically and artistically.

The Herbarium

A considerable amount of time has been spent in getting together, listing and packing herbarium material for loan to various specialists, in particular to those botanists working for *Flora Malesiana*. 2,046 sheets were sent out on loan during the year, and in addition a large number of spirit specimens were sent to a specialist studying figs and fungi. The proper packing of such specimens is laborious and slow. These despatches interfered to some extent with the normal exchange of duplicate material, and although a considerable quantity was ready to be sent out, only 706 sheets could be sent. 1,601 duplicates were received from other institutions. 2,141 sheets were mounted and incorporated into the herbarium during the year, a smaller number than usual, as the mounters were engaged on a programme of repairing old herbarium sheets.

Eleven new sets of herbarium cases were purchased. These were filled by the overflow from the existing overcrowded cases, and as there is no room for further cases in the Herbarium building, extensions will be required in the near future.

Very considerable collections were received from the Forest Department, North Borneo, and Mr. Sinclair spent much time in naming those,

M. R. Henderson

The Sumatran Pine, *Pinus Merkusii*, on Lawn D.

G. H. Addison

A group of succulents raised from seed in Singapore.

G. H. Addison

The African Violet (*Saintpaullia*).

M. R. Henderson

A Spathoglottis hybrid, Singapore Giant, grown as a bedding plant on Lawn O.

M. R. Henderson

A Malayan tree Gardenia, *Gardenia carinata*, by the Office.

Publications

Volume XII, part I, of the *Gardens' Bulletin* was published in April, consisting entirely of a critical revision of the genus *Eugenia* in Malaya by Mr. M. R. Henderson. Part 2 of this volume was published in December, and contains miscellaneous papers on Orchids, Ferns, Nomenclature, Palms, and a list of William Farquhar's Drawings of Malacca Plants, by Mr. R. E. Holttum, Dr. C. X. Furtado and Mr. I. H. Burkill.

The first two of what is hoped will be a series of small booklets, briefly describing and illustrating by means of line drawings, familiar garden plants, were placed on sale during the year. The first describes ten flowering trees, the second ten flowering shrubs. They are sold at fifty cents per copy.

Other work by the members of the Department published during the year included an important paper on the classification of Ferns in the *Biological Review* (Cambridge) by Mr. R. E. Holttum, and several papers, also by Mr. Holttum, on Malayan Orchids in *Chronica Naturæ*, *The Malayan Nature Journal*, and in the *Malayan Orchid Review*, the last named containing a most valuable list of orchid hybrids of the kinds which either are, or could be grown in Singapore. Nearly 400 hybrids appear in the list.

Dr. C. X. Furtado published a paper dealing with the nomenclature of a certain fern in *Lloydia* (America). The first part of Mr. Henderson's popular illustrated account of Malayan Wild Flowers was published by the Malayan Nature Society at the end of the year.

Roads, Buildings, etc

Those roads in the northern half of the Gardens which were in poor condition were made up and surfaced by the Public Works Department. A new access road to the Director's and Assistant Director's quarters was made from Tyersall Road. Vehicular traffic has been restricted to one entrance and to certain roads only in the south of the Gardens. It is believed that this is appreciated by the public, who are free to walk on most of the roads without interference from traffic, apart from numerous bicyclists, who obey no rules and are hard to check. It would probably enhance the amenities of the Gardens considerably to provide a suitable car park and to exclude all wheeled traffic (with the exception of perambulators) as is done in nearly all Botanic Gardens in other countries.

The large and small plant houses, which are used for the display of pot plants and orchids, were repainted and reroofed by the Public Works Department. It was pointed out in the 1948 report that the requirements of roofed houses for the propagation of seedlings, especially orchid seedlings, were still far short of our needs. This state of affairs continues. In 1947, in order to save those orchid seedlings which had survived the Japanese occupation and which were in great danger of being lost because of the dilapidated condition of the only two roofed houses, and to enable the continuation and expansion of the programme of orchid hybridisation, a temporary house was constructed by Gardens labour. This was roofed with a substance called "windolite", which is a sheet of cellulose acetate supported on fine wire mesh. This was used because it is very light and easily handled, but it does not resist the beating action of rain. When, after about nine months, it began to disintegrate and leak badly, it was replaced by corrugated aluminium sheet, light being admitted

by constructing a jack roof, which at first was "glazed" by old X-ray films, from which the emulsion had been removed, and later, when these had proved incapable of standing up to the weather, by glass. This house has proved suitable for orchid seedlings up to a certain stage. The aluminium sheet reflects most of the heat and of course is waterproof and drip proof. It is surprising how quickly drips from a badly made roof will kill seedlings and young plants. But such a house is not suitable for young orchid plants when they have become established and require plenty light, but at the same time protection from heavy rain. At present the only accommodation available is under the porch of the Director's house, a suitable place, but too small to allow of the proper conditions for the very large number of plants being raised. A large glass house is required.

A small glass house formerly erected in the large plant house as a shelter for succulents was removed and rebuilt in a sunny situation on Lawn X. More space is now required for succulents as well as for orchids, and this too must be glass roofed.

Horticultural Work: Botanic Gardens

A high standard of maintenance was reached during the year and most parts of the Gardens were as good as, if not better than they were in pre-war years. The Canna beds along Main Gate Road, which were replanted in 1948, made an exceptionally fine show almost throughout the whole of 1949, and there was no sign of the disease which destroyed them during the Japanese occupation.

Shell splinters damaged a number of trees in early 1942, and although most have either recovered or died, the effects are still being shown in some. Four or five *Eugenia grandis* had to be felled in the labourers' lines because of a rot which followed shell damage. Other losses were a fine old tree of *Eucalyptus corymbosa* on Lawn J and a massive, spreading *Xanthophyllum Curtisii* at the top of Maranta Avenue. The work of concentrating the bamboo collection on Lawn W has continued.

Some alterations were made in the bandstand area, chiefly the grassing over of a number of narrow pathways, which not only improves the appearance of the area by providing an unbroken sweep of lawn, but does away with the constant weeding and trimming of edges. The remainder of the silt from the lake, removed during 1948, was spread over Lawn F, and the area at the head of the lake was improved and planted with ferns and shade loving plants. These grew well but suffered damage by monkeys.

The Lawn Plans were kept up to date by the Horticultural Assistant, so that it is possible to locate any tree or shrub in the Gardens at a moment's notice. 540 large and 260 small labels were painted during the year.

Experiments with several kinds of "plant hormones", or growth promoting substances, supplied by Malayan Fertilisers, were carried out. One of those, Seradix B, in powder form, gave excellent results with Bougainvillea cuttings, increasing the percentage of the rooting of difficult kinds from twenty to one hundred per cent; and in the easier kinds, promoting a more rapid production of roots.

A selection of the best standard Hisbiscus has been planted round the sundial terrace on Lawn J, where they can be seen to advantage.

The sale of plants to the public increased considerably during the year, perhaps because of the increased building programmes in Singapore, both

civil and military, which cause a demand for hedging plants and shrubs and trees for permanent planting. As the stocks of new hybrid orchids increase, more became available for sale to local orchid fanciers and to nurserymen. More than 18,000 plants were sold during the year, bringing in a revenue of $9,900. Of this amount sales of orchid plants accounted for $5,500, which represents merely the sale of surplus material, no labour or expenditure being involved beyond that necessary to carry on the routine work of orchid hybridisation and to keep up a sufficient stock for show purposes. It is obvious that with increased staff and equipment orchid sales could be largely increased, but it should be the policy of the Department not to become a business competitor with the nursery gardener, but to do the initial scientific and experimental work and to ensure that the results of that work are passed on to commercial growers.

Orchids

Nine special beds were constructed during the year for the propagation of those types of orchids which thrive in well drained, rich compost. Some twenty-two new hybrids flowered for the first time during 1949, several of them promising to be valuable additions to the range of free flowering and showy orchids already produced. Two hybrids of the terrestrial genus *Spathoglottis* were produced, both very free flowering, one a dwarf plant which has been named *Spathoglottis Dwarf Legion*, with pale lemon or rosy flowers, the other, called *Singapore Giant*, a large, vigorous and apparently perpetually flowering plant with purple flowers. Amongst the Dendrobiums a cross between *D. Helen Park* and *D. Constance* was flowered, which compares favourably with previous hybrids of this alliance. For some years attempts have been made to produce an orchid with both the vigour and the very free flowering characteristics of the well known Vanda Miss Joaquim, but with improved colour and shape of flower. By crossing a Vanda called *V. Nam Kee*, which is the offspring of parents both of which are hybrids, with another which also has two hybrids as parents, seedlings have been produced which have flowered at a very early stage, producing compact heads of large, well-shaped flowers of a good colour. Up to the present about twenty-five seedlings of this cross have flowered, no two exactly the same. It now remains to grow these on, select the finest, and to wait patiently to see whether they will fulfil their early promise.

Succulents

The collection of succulents was added to during the year, efforts being concentrated mainly on increasing the number of the smaller kinds of Cactaceæ, Mesembs, Stapeliaceæ, etc., which take up less room and are more difficult to grow than the larger Cereus, Opuntia, etc. It is interesting to see how well such things as some of the S. African Mesembs do with correct potting, watering and protection from rain, although they seem very reluctant to flower. Only one, a species of *Bergeranthus*, has so far produced flowers. *Gasteria* and *Haworthia*, however, flower quite freely.

Pot Plants

The display of flowering pot plants was moderately good throughout the year, but the foliage plants improved, and a good show of Anthurium, Alocasia, Begonia and Ferns was maintained. A large number of pots of *Saintpaullia*, the so-called African Violent, was raised from seed. The flowers

of this plant are an inch or more across and range from nearly white to deep violet. A selection of the best plants was made for further propagation, which is done simply and easily by means of leaf cuttings.

Seed Exchange

An important aspect of horticultural work in the Gardens is the exchange of seed with other Gardens and scientific institutions. Two men were kept fully employed collecting, preparing, packing and despatching seed in response to numerous requests from all parts of the world. Over 1,800 packets were despatched and some 750 received.

Government House Domain

The Allen motor scythe purchased in 1948 continued to be useful in dealing with areas still to be cleared of lallang and other rough grass.

Beds and lawns throughout the Domain were kept in good condition, and young trees well manured. The tennis court at the Colonial Secretary's house was topdressed twice during the year and continued to give good service. Levelling, digging and regrassing was done at the houses of the Colonial Secretary, the Under Secretary and the Attorney-General.

Much attention was given to the nursery, where some 1,200 to 1,500 pot plants are kept for decorative purposes in Government House. These plants are changed twice a week. *Clerodendron calamitosum* proved to be a useful and popular pot plant. The nursery also provided a considerable quantity of papaya and avocado fruits.

Other Work outside Botanic Gardens

As in former years, advice was given to various Government, Military, civil and private establishments, as well as to the many individuals who call at the Gardens office for information. Planting was carried out at the Telok Paku holiday bungalow, the Telecommunications Station at St. Michael's Road, in the Cathedral compound, at the Government offices and Raffles' Statue in Empress Place and at the Supreme Court. 150 trees were planted at the Cathedral to replace the old ones removed in 1948. A great improvement to the front of the Government offices was made by planting Tecoma, Hibiscus, Frangipanni and Gardenia, all of which have done remarkably well. Royal Palms were planted in front of the Supreme Court. The usual contact with the Municipal Parks Department was maintained, with whom planting material was exchanged.

Botanical Reserves

The three reserves, at Bukit Timah, Woodlands and Pandan were maintained satisfactorily.

COLONY OF SINGAPORE

BOTANIC GARDENS DEPARTMENT ANNUAL REPORT FOR 1950

BY

M. R. HENDERSON,
Director, Botanical Gardens, Singapore

PRINTED AT THE GOVERNMENT PRINTING OFFICE, SINGAPORE,
BY V. C. G. GATRELL, GOVERNMENT PRINTER

1951

ANNUAL REPORT OF THE BOTANIC GARDENS DEPARTMENT

Staff

Mr. M. R. Henderson was appointed Director with effect from September 1949. The vacant post of Assistant Director was not filled and Mr. J. Sinclair, Curator of the Herbarium, acted in this capacity in addition to his own duties throughout the year. Mr. J. W. Ewart acted as Agricultural Officer, Singapore, in addition to his own duties as Assistant Curator, Gardens. Mr. G. H. Addison proceeded on vacation leave in November. Mr. J. L. Pestana, Laboratory Assistant, was sent to Honolulu on a four months' training course in orchid hybridisation. Mr. G. A. C. Lopez was appointed Library Assistant in November.

The average daily attendance of the labour force was seventy-five in the Gardens, fifty-eight in Government House Domain and nine in the Reserves. In general their health was good. The majority of the Gardens labourers are housed in Gardens quarters.

Botanical Work in 1950

As in 1949, field work outside Singapore was much reduced owing to the emergency. Mr. M. R. Henderson paid a short visit to Kota Belud in North Borneo in April to collect in that vicinity. A fine Gardenia (*G. Merrillii*) was found to be common in this area and seed of it was brought back to Singapore for trial in local gardens. Mr. J. Sinclair accompanied the Forest Botanist, Mr. J. Wyatt-Smith, in September on a short collecting trip to the Gunong Lambak Forest Reserve at Kluang and the Ma'Okil Forest Reserve near Labis. He also spent two weeks in Penang during November and thanks are due to Mr. Ritchings and the staff of the Waterfall Gardens, Penang for providing transport and other help. Mr. Sinclair continued his intensive collecting in Singapore, particularly on the islands off the south-west coast. As a result of these visits thirteen plants new to Singapore were recorded. One of these is *Cordia obcordata*, a tree with handsome red flowers which has been found previously at Mersing and in Penang and Kedah. Other new records are of four grasses new to Malaya, one of which, collected on Pulau Sakeng, has been recorded previously only from New Guinea.

Mr. Sinclair completed a short paper on Bornean Annonaceæ for the *Sarawak Museum Journal*, and continued his studies on Malayan Annonaceæ.

Dr. C. X. Furtado, Assistant Botanist, was engaged upon a revision of *Dæmonorops*, a genus of climbing palms of peculiar difficulty, in which the older species are often inadequately described, and the type specimens, when available, insufficient, so that their interpretation entails much research. Dr. Furtado also determined palm specimens in pre-war collections that still remained unnamed. He supervised work in the library and extracted and indexed references to Malayan systematic and economic botany contained in foreign periodicals.

Part 1 of Volume XIII of the *Gardens' Bulletin*, Singapore was published in June, the whole of the issue being given to a most important revision, illustrated by line drawings, of Malayan Zingiberaceæ (Gingers), written by Professor R. E. Holttum. The second part of *Malayan Wild Flowers*, by Mr. M. R. Henderson, published by the Malayan Nature Society, appeared at the end of the year. Mr. M. R. Henderson and Mr. G. H. Addison published descriptions and illustrations

of new orchid hybrids in the *Malayan Orchid Review* Vol. 4, No. 2. The third in the series *Malayan Gardens Plants*, containing line drawings and brief descriptions of ten orchids, was published.

The Herbarium

The number of herbarium duplicates despatched to other Botanical Institutions increased as compared with 1949, and in all 1,980 were distributed. Much material was sent on loan, chiefly to specialists working on various groups for Flora Malesiana, 2,478 sheets being sent out, as well as a large collection of figs in alcohol.

The Herbarium received in exchange from various overseas institutions 2,345 sheets of duplicates, much valuable material being acquired, as in past years, from the Forest Department, North Borneo. 3,510 sheets were mounted and incorporated in the Herbarium.

All dried material for the Herbarium, and all duplicate material sent out, is thoroughly poisoned to prevent insect attack, especially the ravages of the so-called 'herbarium beetle', which can cause great damage if not checked. The poisoning is done by immersing the specimens in an alcoholic solution of corrosive sublimate. The Singapore Herbarium is housed in well-made teak cases which are in themselves good protection against insects and damp. Because the Herbarium is in constant use any deterioration is quickly detected. As a precaution against insect attack, which, fortunately, has always been almost non-existent, the cases are opened and sprayed at regular intervals with a Gammexane insecticide.

One little known activity of the Department, in which the Herbarium plays a large part, is the identification of plant material for private individuals or for other Government Departments, apart from the routine identification of specimens for the Agricultural and Forest Departments of the Federation, Sarawak and North Borneo, who maintain their own collections and donate duplicates in return for such identifications. Plants suspected of being injurious or toxic are received from the Department of Chemistry; botany students from the University of Malaya or from the local schools bring their collections to be named; people interested in local herbal medicines bring exceedingly fragmentary material to be identified; the Department of Agriculture in Fiji requests information on Chinese drugs imported into that country in order to discover whether any of them may be noxious weeds, and so on. A specimen of a stem was sent from Kuala Lumpur which had been collected in Kedah with an extraordinary recipe for longevity. This was to eat one inch of the stem, which is woody and very bitter, the first day, two inches the second, and so on for forty days.

Horticultural Work

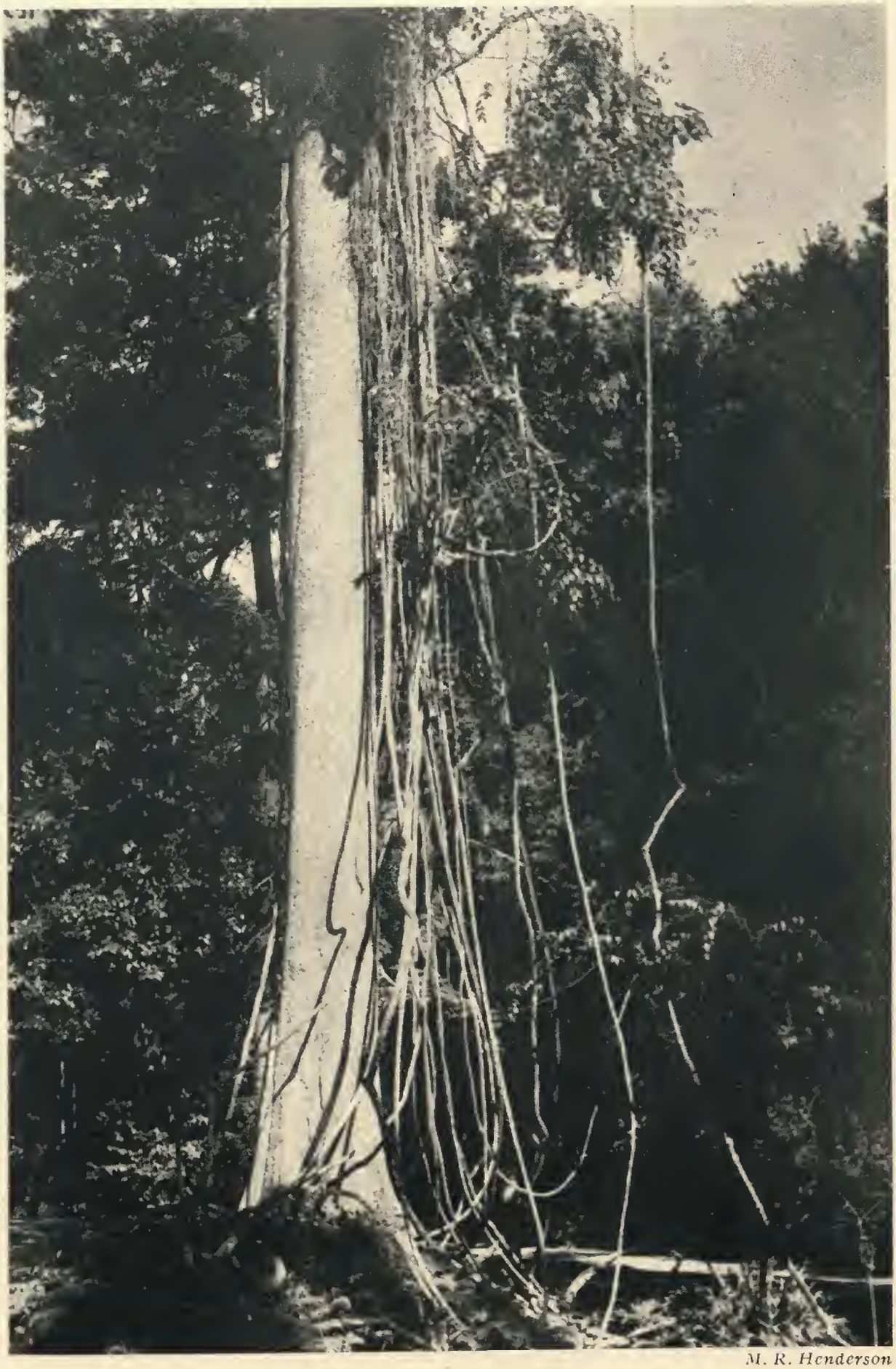
The Gardens continued to be maintained in good order. Their good appearance is due in considerable measure to the efficient working of the three Dennis 24-inch motor mowers, which keep the extensive lawns neatly cut and obviate the necessity of a large labour force employed solely on grass cutting by primitive means. But horticultural work can be mechanised only to a limited extent, and there is more than enough work in the digging of beds and borders, planting, manuring, spraying, propagating, potting and repotting, and the hundred and one other matters that need constant attention, especially in a climate where growth is continuous throughout the year, to keep fully employed the whole of the labour force.

M. R. Henderson

Above: A hybrid Cattleya (*C. Sylvia*). Below: A hybrid Dendrobium (*D. Caesar*).

M. R. Henderson

Below and above on the left: the flower spike and a single flower of *Angraecum eburneum*, an orchid from Madagascar. On the right: one of the Slipper Orchids—*Cypripedium callosum.*



M. R. Henderson

The trunk of a large kempas tree (*Koompassia malaccensis*) near the Bandstand, with large, woody climbers hanging from its crown.

M. R. Henderson

Above: 'Angels' Trumpets'—*Randia macrantha*, an African plant. Below: Rangoon Creeper, sometimes called Drunken Sailor—*Quisqualis indica.*

Roads, Paths and Drains

The Public Works Department resurfaced Office Gate Road and built up the drains along each side. They also made up and tar-sealed the Lake-side Path and the path from Office Gate to Office Ring Road and made up and surfaced with laterite several other paths. A new path was made from Tyersall Gate to the Lake-side Path through Lawn G. One path on Lawn D and two on Lawn P were done away with, the levelling and turfing being undertaken by the Gardens labour force. The mason did a considerable amount of rebuilding and repairing of roadside drains. The P.W.D. filled in a number of silt pits that were found to be breeding mosquitoes.

New Borders and Beds, and New Plantings

A new border encircling the Bandstand was planted with a collection of *Lantana camara* varieties. Another new border was made at the top of the bank on Lawn O and planted with a mixed collection of flowering shrubs, and on the same lawn new beds were made to take several kinds of bulbous plants.

It is intended to form a collection of all the trees used as street trees in Singapore. This collection will, of course, be labelled, and visitors may readily learn the names of any roadside trees in which they are interested. The trees will be sited along Office Ring Road, and ten species have already been planted.

Several changes were made on the Bandstand Hill to endeavour to produce a more colourful display. *Lobelia dresdenensis*, usually grown as a pot plant, was used very successfully as a bedding plant, being readily propagated both by seed and by division.

The Canna beds along Main Gate Road were lifted in mid-February and replanted in March. The width of the beds was increased to six feet, which is considered the minimum for three rows of Canna plants. In April the disease which completely destroyed the Cannas during the Japanese occupation reappeared, but was successfully controlled by spraying with Peronox three times a week for three weeks and thereafter once a week for a month. In spite of this attack, the Cannas made a good display throughout the year.

A considerable amount of work was done on the boundary of Lawn Z, where the hedge had been invaded by tree seedlings and other unwanted plants. The whole of the old hedge was removed and a new one of *Baphia nitida* planted, with oil palms at the Palm Valley end.

An avenue of Royal Palms (*Oreodoxa*) was planted along Office Gate Road in Lawn K. These were all about 1½ feet tall when put out in February. By the end of the year most of them were over 8 feet.

The Lake

The water-lilies flowered well during the year. The upper end of the lake was weeded and the lilies thinned out. Towards the end of the year, one of the several water weeds, *Hydrilla ovalifolia*, appeared to be growing more strongly than usual. In an attempt to control it arrangements have been made to introduce the Gouramy or Kalui (*Osphromenus gourami*), a fish which is said to have been successful in keeping down this plant in Colombo.

Orchids and Succulents

A small part of Lawn X, near the Director's Quarters, has been fenced off and is now being used for all orchid propagation, the raising of succulents, and the preliminary stages of all new introductions. This site is more open and more

suitable for the purpose than the Potting Yard, which is now used for the propagation of those plants which are available for sale to the public and for the supply of foliage and other plants for the Plant House.

Three new houses were built on the Lawn X site during the year. One is a potting shed with corrugated iron roof and brick bins for soil, compost, manure, etc. Of the other two one is roofed with corrugated aluminium sheet, with Perspex lights, and is used solely for new introductions or for propagating plants already in the collections which it is desired to remove to another situation. The other has a glass roof composed of units resembling large cloches, with external blinds of split bamboo for shade when necessary. This house has proved very suitable for the intermediate stages in growing orchid hybrid seedlings and there is some indication that it may help in the problem of growing delicate exotic orchids which dislike the wet Singapore climate. It has also proved suitable for succulents.

More orchid beds were constructed during the year and the old ones given fresh dressings of compost and manure. It is evident that these well-drained beds are at their best in wet weather, when the compost is maintained in a continually moist condition, without, however, becoming sodden or water-logged. During any spell of dry weather the compost tends to become dry and powdery and in this condition is very difficult to moisten. The remedy is, obviously, to have sprinklers working whenever rainfall is lacking, but at the moment the water supply is insufficient in quantity and pressure.

Orchid hybridisation work continues to be pursued with vigour. In order to take advantage of the most up-to-date technique, Mr. J. L. Pestana, Laboratory Assistant, was sent on a four months' course to Honolulu, to study methods used by the large scale commercial growers there, with a view to adapting them to local conditions.

The new orchid hybrids flowered during the year were described and figured in the 1950 issue of the *Malayan Orchid Review*. A noteworthy one was an *Arachnopsis*, which is the second of the bigeneric hybrids between Arachnis and Phalænopsis to be recorded. It was named after Professor R. E. Holttum. The Vanda hybrid mentioned in the 1949 report as an attempted improvement on *Vanda Miss Joaquim* has done well during the year in a bed. It has been christened *Vanda Prolific*.

The large number of orchid hybrids being handled necessitates somewhat elaborate records. A new card index, having three cards for each hybrid, has been begun to keep track of each at all stages of its career. Full descriptions are made of each new hybrid that flowers and accurate coloured drawings made by the artist.

The Botanic Gardens has acquired, over many years, by exchange, or by gift, or collected by the members of the Department, many orchids both of local and of exotic origin which are usually of more interest to the botanist than to the orchid fancier. A collection of small local orchids is maintained in the Plant House, where their diversity of form, habit and flower may be studied. Two exotic orchids, which have been in the collections for many years without flowering, decided, for some unknown reason, to do so this year. One is *Megaclinium purpureorachis*, a native of the Congo, which, like its name, is more curious than beautiful. The other is *Angræcum eburneum* from Madagascar, which has a spike of large, long lasting, white and green flowers.

Although the main interest of orchid growers in Singapore, both amateur and professional, is in the cultivated kinds, several upcountry collectors study native species and not infrequently make discoveries of new species or of species not

yet recorded from Malaya. A case in point is the discovery by Mr. H. J. Vallender in Negri Sembilan of *Eulophia bicarinata*, which, although it is widely distributed from India to Australia, has never before been recorded from Malaya. In spite of its wide distribution not much is known about it and up to the present no botanist has described its leaves. The living plants sent by Mr. Vallender will enable a detailed study to be made.

The collection of succulents was maintained and increased by many acquisitions. Amongst the South African Mesembrianthemums four species of *Glottiphyllum* flowered, as well as two of *Faucaria* and one each of *Bergeranthus*, *Gibbæum* and *Homalium*. *Stapelia Desmetiana*, a South African desert plant, flowered once.

The Sun Rockery on Lawn X, which had become overcrowded and overgrown, was cleaned, weeded and partially remodelled, and a considerable number of succulents such as *Agave*, *Alœ*, *Cereus* and *Opuntia* planted out.

Plant Introduction Section

The banana collection on Lawn R was transferred to Lawn Y. On the area thus left vacant a start was made to develop a plant introduction section where it is intended to bring to the flowering stage all new introductions suitable for outdoor cultivation, except large shrubs and trees. Thirty-five beds, each 12 feet by 3 feet, were made, separated by grass paths, and these will be extended as labour is available. Hedges of Madras Thorn (*Pithecellobium dulce*) and of *Randia spinosa* have been planted to enclose the area.

Nursery

This area is now stocked with sufficient material to meet the requirements of the Gardens, Government House Domain, plant exchanges and plant sales.

Plant Sales

Revenue from the sale of orchid plants was $3,999 and from the sale of other plants, $7,626, a total of $11,625.

Composting

The life blood of any garden in Malaya is manure and compost. Large quantities are needed in the low-fertility, stiff clay of the Gardens and because of the rapidity with which it disappears from the soil in tropical climates. Good supplies of cattle manure have been available from the Veterinary Department, and a cement floored, roofed shed was constructed on Lawn U, near the water tower, to house it. Compost was made in considerable quantities, from leaf sweepings, weeds, household refuse, etc., mixed with manure and spent hops from Malayan Breweries. Horse manure was obtained from the Singapore Polo Club. Trials have been begun of the composting of garden refuse with Adco, without admixture of animal manure.

Singapore Flower Show

An attractive large exhibit consisting mainly of orchids and *Saintpaullia ionanthe* (African Violet) was displayed in the centre of the hall at the Singapore Gardening Society's Annual Flower Show. Much of the success of the show was due to the arrangements of the exhibits by Mr. G. H. Addison, who was Honorary Show Manager.

Plants Inwards and Outwards

Some 536 packets of seeds and 338 plants were received in exchange. 195 packets of seed were purchased. 1,036 packets of seed were sent out in exchange as well as 492 plants. 1,621 plants were supplied to Government Departments and Charitable institutions. 23,419 plants were sold.

Government House Domain

The grounds of the Domain were kept in good condition throughout the year. Various rough areas were levelled and lallang and tree seedlings removed, so that they can be cut by the motor scythe. In particular, the old Malay cemetery, which had become overgrown and a breeding place for mosquitoes, absorbed a considerable amount of labour.

The beds and lawns in front of Government House were replanted and manured when necessary, the Canna beds being replanted twice. Two new orchid beds were made and planted with Singapore hybrids. The lily pond in the new garden was cleaned and the water plants manured regularly. The Hibiscus hedge near the centre gate was removed.

Pot plants in Government House were maintained at a high standard, and, as usual, changed twice a week. Some idea of the work entailed in the proper upkeep of the large number of pot plants required can be gathered from the fact that between 25 and 28 tons of burnt earth were made during the year, all of which is used in potting. To keep up an adequate supply of cut flowers, new nursery beds were made.

Two new hard tennis courts were constructed by the Public Works Department and to accommodate them a large Sentol tree, which, however, was in poor condition, had to be removed. An area adjoining the tennis courts was levelled and turfed and planted with Hibiscus, Acacia and Muntingia. Stigmaphyllon was planted round the fence of the tennis courts.

Several old and unsafe trees in various parts of the Domain were removed. Six Canarium trees were taken out of the back drive in order to make room for the Millettias which were planted there before the war.

Other Work outside Botanic Gardens

The Gardens staff gave advice on planting and layout of gardens to Government, Military and private establishments when asked to do so. Contact with the Municipal Parks Department was maintained and planting material exchanged with them.

Botanical Reserves

A police wireless station was constructed on the summit of Bukit Timah, but as this area was once the site of a house, there were no trees of value upon it and no interference with the native forest resulted. All the reserves were maintained satisfactorily. Thefts of timber were not serious.

COLONY OF SINGAPORE

BOTANIC GARDENS DEPARTMENT ANNUAL REPORT FOR 1951

BY

M. R. HENDERSON,
Director, Botanical Gardens,
Singapore

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1952

STAFF

THE Director, Mr. M. R. Henderson, was on leave from May until September. Mr. J. Sinclair, Curator of the Herbarium, acted as Director during that time. The appointment of Assistant Director has still not been filled. Mr. J. Ewart continued to supervise the work of the Agricultural Department in addition to his own duties as Curator, Gardens. Mr. G. H. Addison, Curator, Parks, returned from vacation leave in May.

The average daily attendance of the labour force was 75 in the Gardens, 57 at Government House Domain and 9 in the Reserves. There was no serious illness amongst them.

BOTANICAL WORK IN 1951

As in the previous two years it is disappointing to have to report the impossibility of undertaking field work on any extended scale, both because of emergency conditions in the Federation and to a lesser extent because of the shortage of senior staff. Mr. J. Sinclair revisited Penang for a month in October and was greatly assisted by Mr. Ritchings and the staff of the Waterfall Gardens, Penang. His visit resulted in the discovery of fourteen species of plants not previously recorded from Penang, of which four are new records for Malaya. Another plant, *Embelia macrocarpa*, was collected for the second time in the same locality that Curtis obtained it in 1887. Mr. Sinclair continued collecting on Singapore Island, demonstrating once more that, even in a well-known area, repeated visits in all seasons of the year will reveal new material. He obtained five new records for the island during the year: *Polyalthia Hookeriana, Centipeda minima, Portulaca pilosa, Olax* sp. and *Nephelium* sp. The Centipeda and Portulaca are introduced weeds, the former common in fallow ricefields in India, Siam and North Malaya, the latter no doubt introduced by Chinese, who use it medicinally. The Olax may be *Olax rosea*, a species known from Sarawak. Other interesting plants found by Mr. Sinclair on Singapore Island include *Brownlowia lanceolata*, found at Ulu Pandan, known many years ago from Kranji and Geylang, but probably extinct in both these localities; and *Artocarpus anisophyllus*, a handsome tree found near Seletar Reservoir, which was previously known in Singapore only from a single tree in the Botanic Gardens.

Dr. C. X. Furtado, Assistant Botanist, continued his work on Dæmonorops, a genus of climbing palms or rattans. Old collections of this genus are often badly muddled, due to the variation in the species and to the lack of knowledge of them on the part of the collectors, so that it is not uncommon to find parts of two or more species mounted on the same sheet. The fragmentary nature of some collections is also a great hindrance to the proper understanding of the species. Twenty-nine species of Dæmonorops are now recognised from Malaya. Dr. Furtado also continued to help in the indexing of references to Malayan systematic and economic botany in foreign periodicals and in writing up references on herbarium sheets, a procedure

which is helpful and time saving to those engaged in the study of any group. Dr. Furtado was also engaged in keeping up to date the nomenclature of plants cultivated in the Gardens, especially of those that furnish seed sent to other institutions.

THE HERBARIUM

The amount of material sent out on loan, especially to specialists working for Flora Malesiana, increased considerably over the 1950 figures, the total being 4,891 sheets, sent to botanical institutions in Leyden, Bogor, Kew, Paris and Hawaii. 2,851 duplicates were received in exchange, the most important accessions being those from the Herbarium Bogoriense in Indonesia and from the National Museum in Manila. Contributions were received also from the Forest Department, North Borneo, and from the Department of Agriculture, New Guinea, this last being a welcome addition, as the Singapore Herbarium, except for the large Carr collection, is poor in material from this region.

The Gammexane insecticide mentioned in last year's report as being used against insect attack in the Herbarium, has not proved entirely satisfactory. A slight attack of 'herbarium beetle' was discovered in the 'Gardens Herbarium', which is a separately housed collection of cultivated plants, and a programme of repoisoning with corrosive sublimate of the whole of this collection was begun.

PUBLICATIONS

Volume XIII, part 2, of the *Gardens' Bulletin* was published in September. This was a mixed number containing papers by Professor R. E. Holttum, Mr. J. Sinclair and Dr. C. X. Furtado. Prof. Holttum described a new Vanilla from Johore and published a revision of the family Marantaceæ. Mr. Sinclair published the description of a new species of Knema, one of the Myristicaceæ, found in South Johore and Singapore. Dr. Furtado contributed a revision of six genera of Malayan climbing palms in which three new species were described.

The third part of Mr. M. R. Henderson's *Malayan Wild Flowers* was published by the Malayan Nature Society, completing the account of the Dicotyledons.

The fourth booklet in the series *Malayan Garden Plants* was published, containing illustrations and descriptions of ten climbers.

HORTICULTURAL WORK

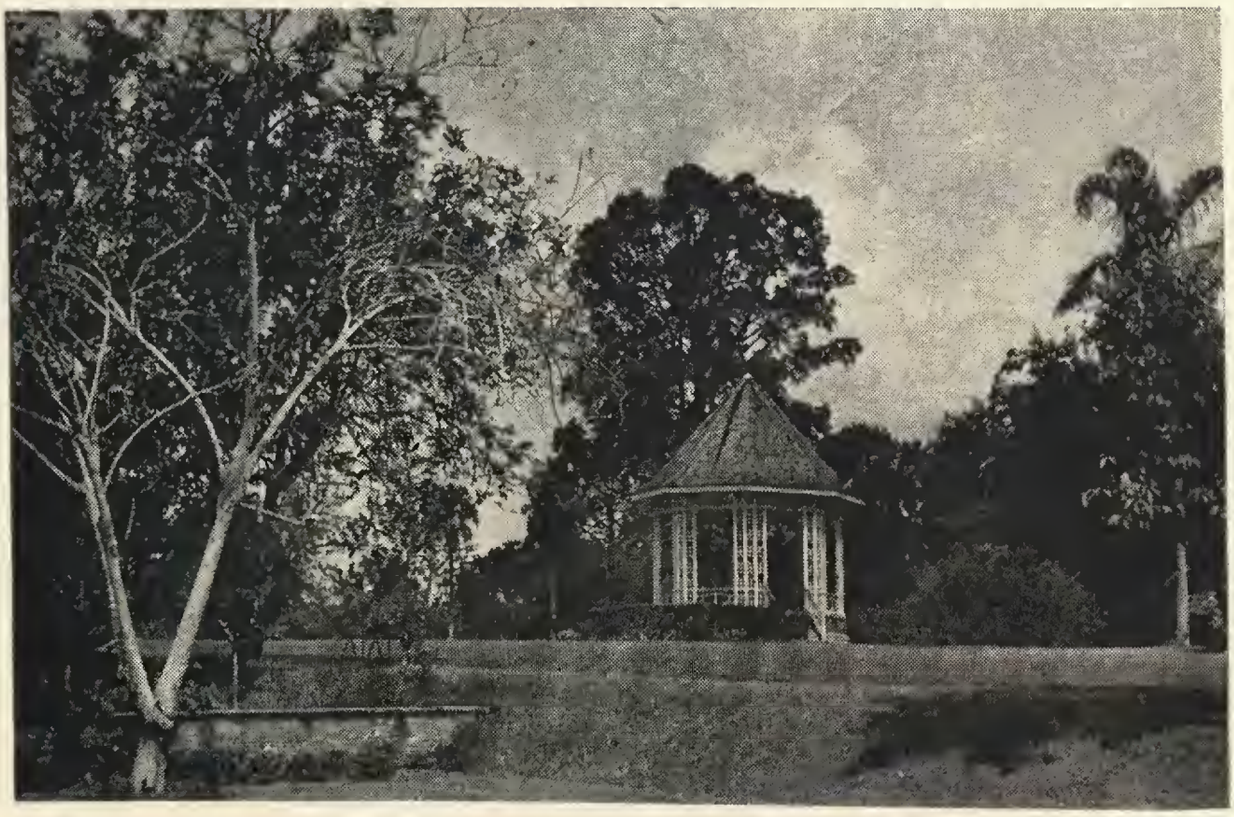
The Gardens were maintained in good condition. Well mown lawns, trimmed and tidy edges and hedges, neat and well weeded beds are of first importance in any public garden. The public responds to such surroundings; and remarkably little damage is done and very little litter left even by the large numbers of people who visit the Gardens at weekends and on holidays.

ROADS, PATHS AND DRAINS

No work was done on the roads or paths by the Public Works Department. In July the level of the Lake was lowered to allow the mason to rebuild 14 feet of the channel feeding the Lake. A footbridge of nibong palm was constructed over this channel. Small repairs to drains and water channels were done by the mason.

M. R. Henderson

Above: *Portlandia grandiflora,* a Tropical African shrub.
Below: *Fagræa auriculata,* a Malayan plant with very large, leathery, cream coloured flowers.



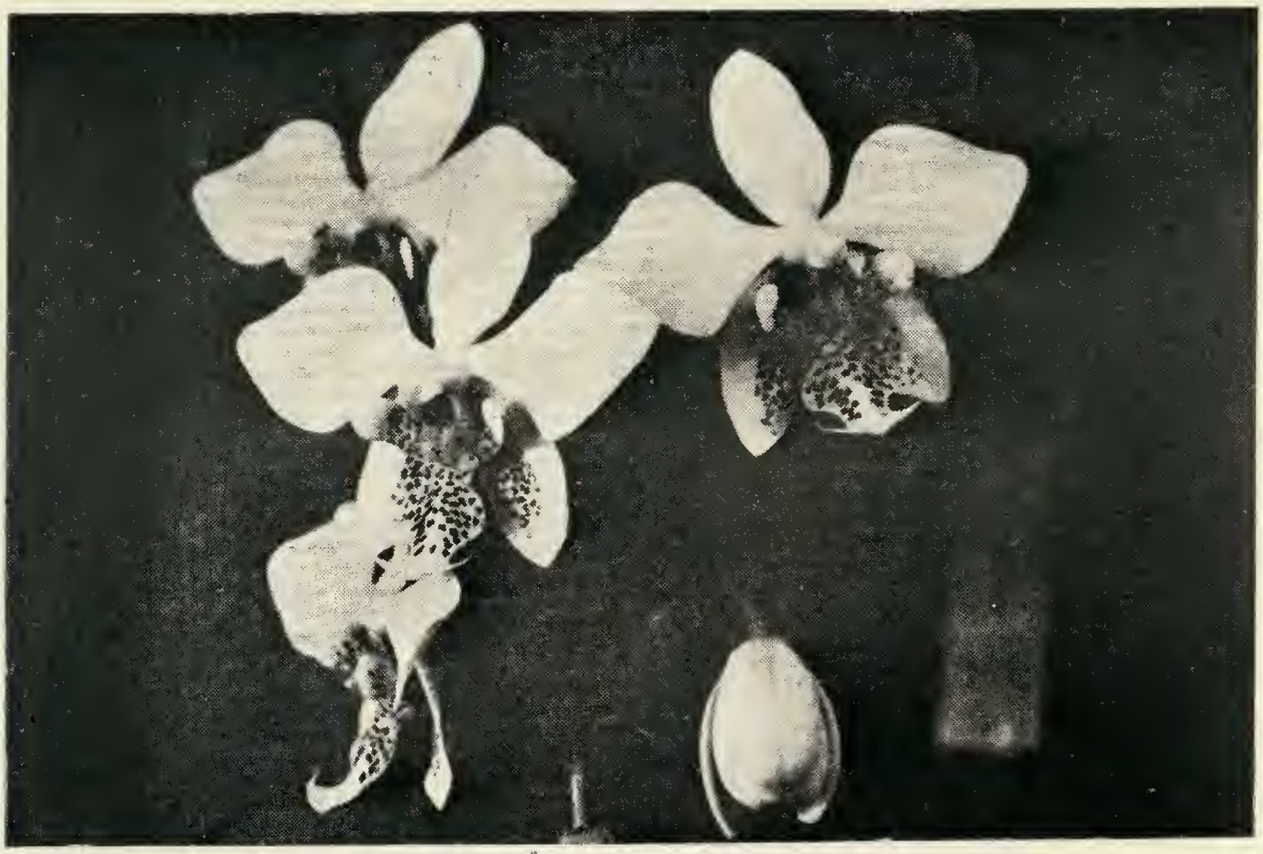
M. R. Henderson

Above: The Bandstand, Botanic Gardens; in the background a large tree of *Dyera costulata* (Jelutong); on the left a tree of *Cochlospermum religiosum.*

Below: *Teysmannia altifrons.* a Malayan Palm.

M. R. Henderson

Above: In the Palm collection in the Botanic Gardens.
On the left: *Heterospathe elata* from Ceram, with behind it a large African Oil Palm. On the right: A fine clump of *Oncosperma tigillaria* (Nibong), native on the seacoasts of Malaya.



M. R. Henderson

Above: *Phalænopsis Schilleriana,* a Philippine orchid.
Below: *Dendrobium John Nauen,* a fine hybrid raised in the Botanic Gardens Singapore. The flowers are white with an orange patch on the lip.

New reinforced concrete tanks for storage of water were built on Lawn T for the orchids and on Lawn X for flowering pot plants, replacing old and unsightly iron drums.

A series of compost bins was constructed on Lawn Z alongside Palm Valley Road, in a position which allows easy loading and unloading of them by the lorry. These bins have proved satisfactory and have turned out considerable quantities of good compost. The present temporary construction of nibong posts and wire netting will be replaced by brickwork as opportunity offers.

BEDS AND BORDERS

The Lantana border planted on Lawn O in 1950 proved less satisfactory than was expected and was removed and replaced by a mixed planting of dwarf shrubs and herbaceous perennials, which is more attractive.

Ixoras from three beds above the plant house were removed to form a hedge on Lawn Z below the Assistant Director's quarters. The beds were remodelled and planted with orange and yellow *Crossandra undulæfolia.*

A new border was made on Lawn L near the office to accommodate the Duranta collection. The Durantas in the border at the eastern end of Lawn O, having become much too big, were removed, the border dug and heavily manured and planted with a collection representing all the Ixoras in cultivation in the Gardens, with between them groups of herbaceous perennials and dwarf shrubs.

In the centre of the lawn near this border the large round bed of *Euphorbia pulcherrima* (Poinsettia), which was becoming untidy, was reduced in size and planted with seedling *Platycodon grandiflorus,* a Campanula-like plant, which made an unusual and attractive display.

The collection of standard Hibiscus surrounding the Sundial Terrace was lifted, manured and replaced, and the plants were improved by this treatment.

A collection of Pitcairnea was planted in a suitable border on Lawn O.

Thirteen species of Strophanthus, mainly African in origin, some of which may have economic possibilities, were put out on Lawn R, but so far growth has been unsatisfactory.

The Cannas bordering Main Gate Road on Lawns A and B were replanted in January and provided a good display until August, when growth became less vigorous. They were then top dressed with cattle manure and continued to provide a reasonable display of colour until the end of the year.

PLANT HOUSE

The plants here were maintained in good order by regular manuring and replacement when necessary. The small planthouse was never without a varied display of orchid hybrids.

THE LAKE

The Lake was cleaned in July when the level was lowered to allow the construction of a new inlet channel. Periodical weeding is done from a boat and this keeps in check the growth of Hydrilla and other water weeds. The Gouramy fish mentioned in the 1950 report as a reputed check on Hydrilla have not yet been obtainable.

ORCHIDS AND SUCCULENTS

The orchid section was extended considerably during the year and more beds for Vanda, Arachnis, Aranda and other terrestrial types were made. Many of the older beds had to have the compost completely renewed and it was found more satisfactory to use very coarse, half-rotted compost which does not break down into dust so quickly.

The number of flasks of seedlings has continued to increase, with over one thousand on the laboratory racks at the end of the year. The number of seedlings in pots has increased in proportion, but without a corresponding increase in space to house them. It was found necessary to dispose of surplus seedlings by sale, to which there was an immediate and enthusiastic response from local amateur and professional growers. The seedlings sold are all well established and of known parentage.

Some fifteen new hybrids were selected during the year as worthy of being kept and named. One was given the name *Aranda City of Singapore*, as it is a large, handsome plant which flowered for the first time a few days before Singapore was raised to the status of a city. It is a cross between *Vanda Dearei* and *Arachnis flos-æris* var. *insignis*, but although the flowers are large and of good colour and form, it appears not to be free flowering, for it has taken ten years to produce its first blooms.

Of the new Vandas, *Vanda Ruby Prince* is the most spectacular, with its deep cyclamen-purple flowers. It is the result of a cross between *Vanda Cooperi* var. *Cho Yam Neo* and *Vanda Ruby*, and is an improvement on both its parents. Two good new Dendrobiums flowered, one called *D. Champagne*, in which some of the seedlings have flowers of an unusual clear yellow; the other called *D. Lim Chong Min*, with large flowers, up to 4 inches across, of a clear orchid pink.

A number of strap-leaved Vandas, generally grown in pots, were planted out in compost beds as an experiment. They have done remarkably well under these conditions, especially *Vanda limbata*, which in pots flowered very occasionally, but in a bed made vigorous growth and flowered almost continuously. Other such Vandas tried out in this way were *V. Dearei*, *V. sumatrana*, *V. Trisum*, *V. Kapoho*, *V. suavis*, *V. tricolor* and *V. luzonica*.

A number of Hawaiian orchid hybrids have been obtained in exchange for Singapore plants and of these several have flowered. The most spectacular is undoubtedly *Vandanthe Rothschildiana*, which has grown and flowered vigorously, producing inflorescences of large, shapely, mauve-blue flowers, with as many as fourteen flowers open at a time. This is a cross between *Euanthe Sanderiana* and *Vanda cærulea*, neither of which can be grown with any success in Singapore.

The succulent collection has been maintained and increased both by new acquisitions and by propagation of existing material. *Stapelia hirsuta*, *Stapelia glabricaulis*, *Echinocactus setispinus*, *Eriocereus Harrissii* and *Glottiphyllum erectum* all flowered during the year. Scale and mealy bug are the chief pests on the succulents but neither has become serious and they can be kept in check by regular weekly sprayings with insecticide.

The collection of Saintpaullias (African Violets) was added to by the introduction of a white variety and a pink one from the Royal Botanic Gardens, Kew.

MISCELLANEOUS

The only new introduction worthy of mention is a white Bougainvillea which was obtained from the Botanic Gardens at Durban through the kind offices of Mr. E. F. Allen. It arrived here towards the end of 1950 and began to flower early this year as a pot plant. It was exhibited at the 1951 Flower Show and attracted considerable attention. It has proved easy to propagate; but none of the specimens planted out in the ground, although they are growing vigorously, have shown any signs of flowering.

Experiments were begun, rather late in the year and unfortunately during a period of very wet weather, to test the theory that ploughing and digging are unnatural and that crops should be grown in a layer of compost on undisturbed soil. Two beds of the same area and close together were prepared, one dug to a depth of two feet, heavily dressed with well rotted cattle manure and compost and raised about 9 inches above ground level, the other prepared by lifting the turf without disturbing the soil below and packing about 2½ inches of fine compost on top. Long beans were selected as the trial crop as they are quick growing and the produce is easy to weigh accurately. The beans grown in compost matured more quickly and yielded a slightly heavier crop, 16 lb. 2 oz., as against 14 lb. 1¾ oz. in the normal bed. The earlier maturing would be a decided advantage in a climate with a restricted growing season, but less so in the wet tropics. There is an obvious advantage in being able to do away with digging, but a good supply of good compost must be available. The experiments are continuing with other vegetable crops and with herbaceous flowering annuals and perennials.

NURSERY

The nursery has been maintained satisfactorily and sufficient plants grown to meet the demands of the Gardens, plant sales, plant exchanges, etc.

At the head of the nursery it was found that in an overgrown thicket there were several cocoa trees which old records indicate are those introduced in 1879. The thicket was cleared, except for overhead shade, and the trees manured, to which their response has been good.

PLANT SALES

Revenue from plant sales was $16,216, of which $10,500 resulted from the sale of orchids. 19,993 miscellaneous plants and 2,702 orchids were sold.

PLANTS INWARDS AND OUTWARDS

773 packets of seed and 196 plants were received in exchange. 208 packets of seed were purchased. 2,238 packets of seed, 83 orchid plants and 84 other plants were despatched in continuation of our exchanges with other institutions and with individuals.

SINGAPORE FLOWER SHOW

Mr. G. Alphonso, Horticultural Assistant, was assistant Show Manager at the annual Flower Show sponsored by the Singapore Gardening Society. The Gardens staged a large exhibit, mainly of orchids, and Mr. J. L. Pestana, Laboratory Assistant, arranged an exhibit to demonstrate the parentage of orchid hybrids raised in Singapore.

GOVERNMENT HOUSE DOMAIN

The concrete plant house built during the Japanese occupation on the lawn in front of Government House was demolished and a lily pool constructed on the same site. The demolition and new construction were done by the Public Works Department, while the staff of the Domain completed the levelling, turfed the area and extended the existing rock garden to surround the pool. Two pergolas, one on either side of the pool, were put up by the P.W.D. and on them were planted Clematis and *Mucuna Bennettii*.

A sufficient stock of plants in pots was maintained to enable them to be changed twice a week in Government House and other residences in the Domain.

Various new plantings were made, including *Pleiocarpa mutica*, a West African plant which flowers profusely in Singapore but which does not set seed and defies attempts to propagate it vegetatively. A plant of it was got from Kew and put out in the rectangle behind Government House, where it has made good growth.

A few old trees were lost during the year. A very fine large Angsana near the back drive had to be severely pruned after a large branch had broken off during a storm. Fortunately the stump has sent out vigorous new shoots and the tree may eventually regain some of its former glory.

NATURE RESERVES

Important and timely legislation the Nature Reserves Ordinance No. 15 of 1951, came into force early in the year, providing for the dedication and administration of certain lands in the Colony of Singapore as Nature Reserves. These lands include the former reserves at Bukit Timah, Kranji and Pandan, as well as the water catchment areas in the centre of the island and the cliff at Labrador, and are administered by trustees who constitute a Board of Management with the Director of Gardens as Chairman.

COLONY OF SINGAPORE

BOTANIC GARDENS DEPARTMENT ANNUAL REPORT FOR 1952

BY

M. R. HENDERSON
Director, Botanical Gardens
Singapore

Printed at the Government Printing Office, Singapore
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1953

STAFF

THERE was a serious shortage of senior staff for the greater part of the year. Mr. J. Sinclair, Curator of the Herbarium, was on leave in the United Kingdom from May to November, Dr. C. X. Furtado, Assistant Botanist, went on leave in July prior to retirement, and Mr. J. W. Ewart, Curator, Gardens, was so fully occupied with the duties of Agricultural Officer and Food Production Officer that he had little time for horticultural duties in the Gardens. Mr. G. Alphonso, Horticultural Assistant, was absent for several months on sick leave. The post of Assistant Director has not yet been filled, in spite of efforts both locally and overseas to find suitable candidates. Mr. M. R. Henderson, Director, and Mr. G. H. Addison, Curator, Parks, were on duty throughout the year.

The average number of daily paid labourers employed at the Gardens was 79 and at Government House Domain 57.

BOTANICAL WORK AND THE HERBARIUM

No field work was possible during the year, mainly because of the lack of senior staff and also because of the continued uncertainty of conditions in the Federation. Mr. M. R. Henderson, while on a short vacation at Fraser Hill, made a collection of mosses and liverworts which have been sent for naming to a Dutch specialist in these groups. Mr. Henderson also continued, when time permitted, the study of *Calophyllum,* a genus of forest trees of the Mangosteen Family, which are of some importance as timber trees. This study is being undertaken in collaboration with Mr. J. Wyatt-Smith, Forest Botanist, Federation of Malaya. Mr. Wyatt-Smith was on leave during the year and took the opportunity to visit the Herbaria at Kew and Leiden to examine type material not available in Singapore. As a result it has been found that at least two of the common species have for many years been going under wrong names and that many others have been badly confused. Unfortunately this means that familiar specific names must be dropped and unfamiliar ones used instead. *Calophyllum* is a peculiarly difficult group to study, for the leaves and flowers of all species are much alike. Comparison of bark characters has been found of value and much material has been specially collected by Forest Officers, and copious field notes made, to enable such comparisons to be made.

During his leave Mr. Sinclair spent some time working in the Herbaria at Kew and Edinburgh in order to complete his account of the family Annonaceæ and to make a preliminary survey of the Nutmeg Family (Myristicaceæ) with a view to beginning a revision of the numerous Malayan species of this family.

Mr. Henderson completed the preparation and illustration of a popular account of the local Monocotyledons (which include the orchids, gingers, sedges and grasses) as a sequel to his Malayan Wild Flowers (Dicotyledons). It is hoped that the Malayan Nature Society will undertake to publish this in 1953.

Two small but interesting collections made in Malaya by persons not attached to the Gardens staff have been donated. One was from the little known Gunong Padang and Gunong Sembilu in Trengganu, made by Mr. J. A. Hislop, and the other was a collection of ferns from various localities, made by Mrs. G. B. Molesworth-Allen. A number of interesting plants have

been received from Mr. M. G. Dickson of Kuching, Sarawak, and no fewer than three small collections from Mount Kinabalu in North Borneo have been examined and named.

The Herbarium continues to receive considerable accessions of material from overseas institutions. Only 1,009 sheets were sent out this year, but 3,263 were received. The largest consignments came from the Herbarium Bogoriense, Indonesia and the Rijksherbarium in Leiden. Other donors were the Arnold Arboretum in America, the Forests Departments of North Borneo, Dehra Dun in India and Lae in New Guinea, the National Museum in Manila and the University of Delhi.

Botanists working on Flora Malesiana, the vast project sponsored jointly by the Indonesian and Dutch Governments which aims at publishing a complete and up-to-date Flora of the whole Malaysian region, are obliged to study material from the Singapore Herbarium and this is freely loaned to recognised botanical institutions for the use of specialists engaged in revising particular groups of plants. This year Flora Malesiana botanists have asked for and received no fewer than 6,905 sheets from Singapore, considerably more than in past years. Loans made in previous years are now beginning to be returned. The Singapore Herbarium benefits greatly from this study of its collections by overseas botanists, for much previously unnamed material is now named, mistakes are rectified and gaps are filled.

PUBLICATIONS

A paper on Bornean Annonaceæ by Mr. J. Sinclair was published in the *Sarawak Museum Journal* Vol. 5, No. 3, in which three new species were described.

The fifth booklet in the series *Malayan Garden Plants*, describing and illustrating ten palms of horticultural interest, was published and put on sale.

It was not possible to issue a *Gardens' Bulletin*, but material for a further number was sent to the printer towards the end of the year.

A second edition of Mr. E. J. H. Corner's *Wayside Trees of Malaya* printed by the Government Printing Office, Singapore, appeared during the year. This work has been completely reset and contains additions by the author to bring it up to date. All the line and half-tone blocks which illustrate this book were carefully preserved in the Botanic Gardens during the Japanese occupation and survived intact.

Plans for a new *Flora of Malaya* to replace the present standard work, Ridley's *Flora of the Malay Peninsula*, now out of date, have begun to mature. The first volume of the new Flora, which is to be a complete, illustrated account of all the orchids native in Malaya, as well as the hybrids and the commonly cultivated exotic species, written by Professor R. E. Holttum, was in the final stages of proofing at the end of the year. This book will be indispensable not only to the systematic botanist and orchidologist but also to those who grow orchids in their gardens or are interested in producing new hybrids, for it contains much information on cultivation and on the raising of orchid seedlings.

Descriptions and photographs of new orchid hybrids raised in the Botanic Gardens, prepared by Mr. M. R. Henderson and Mr. G. H. Addison, were accepted for publication by the Orchid Review of London. Such descriptions, which are necessary under the Rules of Botanical Nomenclature to validate the names of new hybrids, have hitherto appeared in the *Malayan Orchid Review*, which is the most suitable place for them, but unfortunately this periodical has not been published since 1950.

M. R. Henderson

On the left: A large *Corypha* palm flowering at Taiping, Perak in 1922.

On the right: *Borassus flabelliformis* in the Botanic Gardens.

G. H. Addison

Above: The Herbarium as it was in 1907.
Below: The Herbarium as it is today.

G. H. Addison

Singapore Standard

Above: A spray of the white *Bougainvillea.*

Below: Racks of seedling orchid hybrids in flasks in the Botanic Gardens laboratory.

M. R. Henderson

On the left: *Bauhinia kockiana,* a Malayan climber.
On the right: *Zingiber Ottensii,* 'Lempoyang Hitam', a ginger often cultivated in Malaya.

HORTICULTURAL WORK

Although the Gardens were maintained in good order throughout the year, very little experimental work could be undertaken owing to the shortage of staff.

ROADS, PATHS, ETC.

No work on the Gardens' roads has been necessary although at the end of the year some parts begin to show signs of wear. The Gardens' mason made rather extensive repairs to brick drains and to the tiled benches, cement paths and drains in the large Plant House.

NEW CONSTRUCTION

A Crittal glasshouse was erected close to the Director's quarters. This is a pre-fabricated house of light aluminium, the framework being imported from England. The glass was cut locally. The framework was erected and the glass fitted by the Gardens' staff and although no putty has been used in glazing, the roof is rain-tight. A plant house such as this, completely enclosed in glass, is something of an innovation in this country and it is intended as an experiment. Very high humidity and very high temperatures can be obtained in such a house, but very high temperatures are not wanted and overhead screening will be provided. Preliminary tests have shown severe scorching of the foliage of some plants, an interesting point being that fully mature leaves of such orchids as Dendrobium scorch much more readily than the young growths.

The temporary compost bins near the Nursery, mentioned in the 1951 Report, have been replaced by more permanent ones of brick. They are in constant use.

PLANT HOUSES

One of the steel pergolas in the large Plant House collapsed under the weight of a heavy growth of Bauhinia.

The pot plants here were maintained in good condition. The collection of Malayan ferns was resorted and the names checked. The Dracæna collection was severely attacked by beetle and regular sprayings had to be carried out to check this.

A feature of the Plant House which never fails to attract attention is the flowering of *Mucuna Bennettii,* a large Leguminous climber from New Guinea. Its heaviest flowering is usually towards the end of the year and in early December it was covered with trusses of large, flame-coloured flowers, both outside and hanging from the roof inside. This plant has been propagated and distributed and is now not uncommon in private gardens in Singapore and elsewhere. The Gardens' plant will set seed only after hand pollination, but other plants in other parts of Singapore, the progeny of this one, appear to set seed freely by natural means.

BEDS AND BORDERS

The Canna beds along Main Gate Road were replanted in the latter half of the year and have since made good growth.

A considerable number of old beds were manured and replanted. Sixty-four new beds were made, in which a variety of plants were put out. A large number of new palms were planted on Lawn X. A small collection of various varieties of Bananas, located in low-lying ground near the Nursery, were found not to thrive here and were moved to a new site on Lawn R, where a number of economic plants are concentrated. Considerable trouble was encountered here in clearing away an introduced yam *(Dioscorea zanzibarensis)* which is tending to become a major pest in some parts of the Gardens.

ACQUISITIONS AND LOSSES

Few plants worthy of note here were introduced during the year. A white variety of *Salvia coccinea*, the seed of which came from the Botanic Gardens at Perideniya in Ceylon, promises to be a pleasing bedding plant; and *Lantana trifolia*, which came from Italy, is unusual because of its spikes of lilac berries. The white Bougainvillea mentioned in previous reports, which has been planted out near the office, is now beginning to flower freely. It is easy to propagate and is now being made available to the public.

A curious incident occurred when a tall palm near the Laboratory *(Corypha gebanga)* was struck by lightning. This palm grows to its full size in about 25 years, then flowers and dies. This particular specimen must have been close to maturity, for the lightning apparently shocked it into a premature and poor flowering, very unlike the enormous and spectacular plume which occurs under normal circumstances. The lightning also stripped the base of the trunk of an accumulation of epiphytic ferns and orchids and threw the debris in all directions for a distance of several yards.

An ugly gap in Maranta Avenue was caused by the fall of a large *Parkia Roxburghii* which brought down with it two other trees. The stumps of these trees are quickly hidden by foliage plants and small palms.

THE LAKE

The Sacred Lotus Lily, *Nelumbium speciosum*, which carries its leaves and flowers high above the surface of the water, has spread rapidly after what must have been an accidental introduction of it a few years ago, and although it is a picturesque and beautiful plant, it is in danger of becoming a pest and crowding out the smaller Water Lilies (Nymphæa) which have floating leaves and flowers.

A curious water-fern, *Salvinia auriculata*, was introduced from Bogor and put in the Lake early in the year. This has also spread rapidly and covers large patches. It is more easily controlled than the Nelumbium, as it floats on the surface and can be skimmed off.

ARBORETUM

This area was cleared of undergrowth, unwanted seedlings and thickets.

ORCHIDS AND SUCCULENTS

The production of orchid hybrids proceeded as in previous years, but it so happens that fewer new hybrids than usual have flowered during 1952. Amongst these, however, are some of interest and quality. The finest, no doubt, was Vanda Tan Chay Yan, a cross between Vanda Josephine van Brero (itself a hybrid of Vanda teres and Vanda insignis) and Vanda Dearei, a Bornean species. The seed of this cross was presented to the Gardens by Mr. H. S. Tan and the first seedling flowered under the care of Mr. Tan Siew Kuah. The flowers are large—about 9 cm. across—and well-shaped, and the general colour is orange-peach with some orchid purple and a few crimson spots. Two similar Vanda hybrids which flowered for the first time are Vanda Wong Peng Soon (called after the World Badminton Champion) and Vanda Sir Man Kam Lo. Both these crosses were made by Mr. John Laycock and both have proved to be remarkably free flowering. A good new Dendrobium is D. Rosalind Lee, the parents of which are Dendrobium Medusa and Dendrobium stratiotes. An interesting bigeneric cross between Vanda lissochiloides and Arachnis Ishbel flowered this year, but has taken twelve years to do so. Such crosses are called Vandachnis and our one has been christened V. Scarlet Runner. It is the second Vandachnis to be recorded; only one plant exists,

The flowers are attractive in shape and colouring but the inflorescence is unpleasingly long and floppy, with the flowers spaced too far apart. Further crossings are necessary, and are being made, to improve the shape of the inflorescence.

Some 350 pollinations were made during the year, not all of which, of course, yield seed. Numerous crosses involving various kinds of Aranda (Arachnis-Vanda hybrids) were attempted, mostly without success. Large pods may result, but they are usually quite devoid of seed.

The introduction of a number of fine hybrids from Honolulu has enabled a number of crosses to be made between them and locally produced hybrids.

The beds in which various Vandas, Arachnis, Arandas, Arantheras, etc. are grown have been kept supplied with half-rotted compost well heaped up round the bases of the plants. This takes a great deal of compost, but the plants benefit.

A number of the less hardy strap-leaved Vandas, some Cattleyas, Dendrobiums, etc., were transferred to hanging baskets filled mainly with large pieces of charcoal and given light shade. There is no doubt that the plants respond to this treatment, and a plant of *Euanthe Sanderiana,* always delicate in Singapore, is growing well under these conditions.

The number of flasks of seedling orchid hybrids on the racks in the Laboratory totalled 1,200 at the end of the year. This represents an enormous number of seedlings.

Some changes have been made in the culture medium and certain experiments have been initiated by Mr. J. L. Pestana to ascertain whether the growth rate and vigor of the seedlings can be increased. The acidity of the medium has been increased to pH 5 from approximately pH 6.2 and the acid used has been changed to citric acid in preference to hydrochloric acid, which has been used hitherto. Better germination has been observed, and there has been an appreciable increase in the rate of growth; at the same time the seedlings appear to be healthier and sturdier.

The control of infection of flasks by moulds is extremely important. Considerable improvement in this respect has been made by impregnating the cotton wool plugs with 0.1 per cent mercuric chloride and 0.1 per cent picric acid dissolved in absolute alcohol. Previously, the plugs were disinfected with a solution of copper sulphate, but this tends to cause shrinkage of the plugs and opens gaps between them and the necks of the flasks which admit fungus spores. The new technique has resulted in almost complete control.

When seedlings are removed from their flasks and put out into pans in finely broken brick, their growth is checked. They are watered with tap water, which is considerably more alkaline than the medium in the flasks, and to ascertain whether this check in growth is due to the difference in pH between conditions in the flask and conditions outside, the water used for watering the seedlings is now acidified to pH 5 and careful watch is being kept for results.

The succulent collection has been increased by the introduction of seed and plants from abroad and has been kept in good order. Some plants of Conophytum, Lithops, Faucaria, Pleiospilos, etc., of the Mesembryanthemum Family, native in the driest parts of South Africa, have grown remarkably well. One Conophytum has flowered.

PLANT SALES

Revenue from plant sales was $18,862, of which $14,500 resulted from the sale of surplus orchid plants and seedlings. 22,900 plants were sold, of which 2,900 were orchids.

PLANTS INWARDS AND OUTWARDS

368 plants and cuttings, including orchids, were received in exchange and 335 sent out to individuals and institutions with whom exchange relationships are maintained. 775 packets of seed were received and 608 sent out, while 230 packets of seed were purchased. The Gardens' staff collected 59 kinds of seed and 22 plants for cultivation. 385 plants and 20 packets of seed were donated to the Gardens and 2,140 plants were given by the Gardens, mostly to new gardens at Government quarters and other buildings.

GOVERNMENT HOUSE DOMAIN

Their Royal Highnesses the Duchess and Duke of Kent stayed at Government House during their visit to Singapore and a special effort was made to have the Domain, the pot plants and the cut flowers for Government House at as high a standard as possible. The labour force responded well to a call for extra effort. Orchid plants and flowers were brought from the Botanic Gardens to supplement the decorations in Government House and the Australian Government sent two parcels of Australian flowers which provided a new and unusual note.

During the Royal visit, two Peltophorum trees were planted on the lawn in front of Government House, one each by the Duchess and the Duke.

The old Nursery, situated near the Potting Yard, was moved to a new site beyond the Comptroller's house. The old site was levelled and turfed to provide a children's playground. The new nursery has been fenced, the beds dug and planted and a water supply has been laid on by the Public Works Department. The soil here is good and there has been a marked improvement in the growth of vegetables and flowers. The large amount of compost required in the new nursery has held up the replanting of the Cannas and the hedge along the 'Out' road, but stocks are now rapidly being built up.

The building of three new blocks of quarters near the Potting Yard has necessitated some changes in this area, including the removal of a few trees. The fencing-in of the Potting Yard was begun, and all the pot plants, both foliage and flowering, are being concentrated here.

Rough areas on the perimeter of the Domain have been largely reduced by the use of a second Allen Motor Scythe.

Government House Domain competed successfully in the Annual Flower Show and was awarded several prizes for pot plants and cut flowers.

SINGAPORE FLOWER SHOW

Mr. G. H. Addison was Show Manager of the Annual Flower Show sponsored by the Singapore Gardening Society. This year's show was honoured by the presence of several well-known figures in the horticultural world, who arranged their tours to arrive in Singapore in time for the show and to act as judges. These were Mr. Rodney Wilcox Jones, a past President of the American Orchid Society, Dr. Ernest Soysa, a past President of the Ceylon Orchid Circle, Mr. David Sander of the famous orchid firm Sanders (St. Albans) Ltd., and Mr. L. Maurice Mason from England, a well-known expert on foliage plants and begonias.

The Gardens staged a large centre exhibit, mainly of orchid hybrids, and an interesting exhibit of succulents. They were awarded the City Council's Challenge Cup for the finest Singapore bred orchid hybrid in the Show, the exhibit that carried this off being a fine plant of Dendrobium John Nauen.

COLONY OF SINGAPORE

ANNUAL REPORT OF THE BOTANIC GARDENS DEPARTMENT FOR 1953

BY

M. R. HENDERSON
Director, Botanic Gardens
Singapore

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1954

STAFF

Mr. M. R. Henderson, Director, Mr. J. Sinclair, Curator of the Herbarium and Mr. G. H. Addison, Curator, Parks, were on duty throughout the year. Mr. J. W. Ewart, Curator, Gardens, was on leave until July and on his return resumed part time duty as Agricultural Officer, Singapore. Dr. C. X. Furtado, who retired from the post of Assistant Botanist in 1952, was re-employed in the same capacity. Mohamed Nur bin Mohamed Ghose, Herbarium Assistant, retired after forty years' service and was re-employed in the same post. The post of Assistant Director still remains vacant.

The average number of labourers employed in the Gardens was seventy-nine and at Government House Domain fifty-seven.

BOTANICAL WORK AND THE HERBARIUM

More field work was possible in 1953 compared with the previous year and more collections were made.

Mr. Sinclair made four short visits to Gunong Pulai in South Johore, which is now accessible to the summit by a jeep road. Transport and escorts were kindly provided by the O.C.P.D., Kulai. Collecting was done mainly in the ravines of the Sungai Ayer Hitam Besar and Sungai Ayer Hitam Kechil, and one trip was made to the summit. Here *Rhododendron longiflorum* was observed in full bloom. This is an epiphytic Rhododendron which is often found high up on tall trees. Unfortunately little flowering of the shrubs or of the taller trees was observed on any of the visits.

Mr. Sinclair spent three weeks during July in Trengganu, collecting along the coast and at Dungun and Bukit Besi. Some 186 numbers were obtained, the most interesting material coming from the lowland forest at Sri Bangun near Bukit Besi and from the Trengganu-Besut road. Preliminary examination shows that about 22 per cent of the plants collected have not previously been recorded from Trengganu and that about 14 per cent are new to science, but as this large area has not been intensively collected, these results are not surprising. Mr. J. S. Addison, Mr. C. L. Carrier and Inche Ibrahim bin Abdul Kadir of the Forest Department very kindly helped in providing transport during this expedition.

In November Mr. Sinclair spent eighteen days at the Forest Research Institute, Kepong, from whence visits were made to various places of botanical interest in the vicinity. Collecting was done at Weld Hill, a small Forest Reserve in the heart of Kuala Lumpur, which is the type locality for many Malayan plants; on the limestone at Batu Caves; on the quartz of Klang Gates; in the peat swamp forest at Telok, Klang; and in the lowland forest at Sungai Menyala, Port Dickson. In this last locality the Forest Department has set aside blocks of forest which are protected from exploitation and in which most of the trees have been identified and labelled, so that individual trees may be studied over long periods of time. Thanks are due to Mr. A. V. Thomas for permission to use the facilities of the Library and Herbarium of the Forest Research Institute, and to Mr. J. Wyatt-Smith for help in field work.

Mr. Sinclair continued his collecting of Singapore plants, with the result that several rare plants were found, at least six of which are new to the Singapore flora. These include Cymodocea, a marine flowering plant, which was found at Tanah Merah Besar.

Dr. C. X. Furtado continued his studies of the climbing palms of the genus Calamus, which are of considerable economic interest in that they provide rattan of commerce.

Mr. Henderson began preliminary work on a revision of the Mahogany Family (Meliaceæ) in Malaya. This is a large family of shrubs and trees of lowland and hill forest. Much material has accumulated since the last account of it in Ridley's *Flora* in 1922, and it is evident that a considerable number of new species will have to be described.

Mr. Sinclair completed his account of Annonaceæ in Malaya and the manuscript was almost ready at the end of the year to be sent to the printer for publication in the *Gardens' Bulletin.* He began work on the Nutmeg Family (Myristicaceæ) of Malaya, another large family of forest trees which requires revision.

The number of duplicates received by the Herbarium in exchange was 1901, less than in 1952, but the material was of good quality and very valuable. It came from the Forest Department, North Borneo; the Forest Department, Lae, New Guinea; the Forest Research Institute, Dehra Dun, India; the National Museum, Manila; and the Herbarium Bogoriense, Indonesia. Very few duplicates could be sent out during the year but a very large number has been prepared for distribution in 1954. 2,563 sheets were sent on loan, mostly to botanists working on Flora Malesiana. 1,636 sheets were mounted and incorporated in the Herbarium. The mounters were kept busy on a programme of re-poisoning mounted sheets.

Visitors working in the Herbarium at various times during the year were:—Mrs. B. E. G. Molesworth-Allen (Ferns of Malaya); Mr. Gordon de Wolfe, an American student at the University of Malaya, studying local ferns and orchids; Mr. Trivedi of India, studying ferns; and Mr. J. Wyatt-Smith, Forest Botanist, Malaya.

PUBLICATIONS

The most important departmental publication during the year, and, indeed, the most important one yet published, was *Orchids of Malaya* by Professor R. E. Holttum, the first volume of a proposed revised *Flora of Malaya.* This was issued as a fully bound volume complete with dust cover in colour, of 753 pages and many illustrations. By a generous donation the Singapore Gardening Society made it possible to include four full page colour illustrations of orchids. Apart from the blocks for these illustrations the entire volume was produced by the Government Printing Office, Singapore, who are to be congratulated on the excellence of the technical details of printing, binding, etc. The second volume of the Flora will be *Ferns of Malaya,* also written by Professor Holttum. The setting and preliminary proof reading of this volume was completed by the end of the year.

Volume 14, part I of the *Gardens' Bulletin, Singapore,* was published in August. This issue contains articles by several authors on various aspects of Malayan botany. Several new species are described and a number of new records are given for the flora of Singapore. An interesting and unusual article by Mr. I. H. Burkill, at one time Director of the Botanical Gardens, deals with vegetables eaten with their rice by Malays in Perak, revealing that more than 100 different kinds were used. The most important paper in this issue was one by Dr. C. X. Furtado on the genus Dæmonorops in Malaya. This is a group of climbing palms or rattans of great complexity and difficulty from the botanical point of view. Dr. Furtado provides full descriptions and illustrations of 32 species, of which 4 are described as new.

Descriptions and illustrations of new orchid hybrids raised in Singapore were published in the *International Orchid Journal,* U.S.A., by Messrs. Addison and Henderson.

An illustrated article describing suitable ornamental and shade trees for Malaya, with additional notes on Palms and Hedges, in which methods of planting, manuring and pruning were given, was published in the *Malayan Forester* by Messrs. Addison and Henderson. This was later issued by the *Malayan Forester* as a separate pamphlet for sale to the public.

HORTICULTURAL WORK

The bulk of the work done in any one year is made up of numerous small items such as routine planting and replanting, manuring, small improvements, etc., which need not be detailed. Only the larger items, on which a considerable amount of time and labour were expended, or those which alter the appearance of parts of the Gardens are mentioned here.

One considerable undertaking was the removal of the Chinese gardener's benches and potting shed from the old site on Lawn Z to a new one in the Nursery. This was done to reduce the labour previously required in handling pots and in pumping water. Close access to the benches by lorry is now possible and the water tanks are fed by gravity from a spring at the head of the Nursery. A new potting shed and a roof under which burnt earth can be prepared were built on the new site.

The small plant house, which previously had a slatted wooden roof partly covered by creepers, was re-roofed with corrugated aluminium sheet and Perspex. This was done to allow the display of a more varied collection of plants, including succulents, which require as much sunlight as possible and complete protection from rain. The work was done by the Gardens staff and included the removal of a large clump of Sealing Wax Palm in the centre of the house, the resurfacing of the benches and the clearing away of undergrowth and some trees round the house to admit more light.

A representative collection of small succulents, some planted out in a miniature rockery, some in pots, was arranged along the sunniest side of this house and have done well here. As many hybrid orchids as possible are displayed, as well as collections of foliage plants, ferns, begonias, etc.

The Lake was cleaned and weeded during the early part of the year. Large quantities of the Sacred Lotus (*Nelumbium speciosum*) and the water fern *Salvinia auriculata,* mentioned in the 1952 Report, were removed, as well as the usual weeds. All this material is composted.

A considerable amount of clearing was done along the boundary from Office Gate to the large planthouse and also along the side of the planthouse. This area had gradually become overgrown with unwanted seedling trees and shrubs. One result of this work was to show to better advantage a fine specimen of *Kurrimia paniculata,* a native Malayan tree which when it flowers is covered with innumerable spikes of tiny white flowers. Another result was the opening up of the side of the planthouse, where further improvements in layout are planned.

The avenue of Royal Palms along Office Gate Road, the first section of which was planted in 1950, was continued down to Cluny Gate. The young plants have all made good and even growth. The older ones, planted in February 1950, are now approximately 32 feet tall.

Towards the end of the year a programme of alterations to the Bougainvillea collections, behind the Canna beds on Lawn B, was begun. This was

undertaken in order to provide space for new kinds and to improve the appearance of the larger specimens, many of which had grown too large or had developed untidy and straggly growth.

Various gravelled paths in several parts of the Gardens were turfed over in order to save labour in keeping the edges neat and the paths themselves weeded and because of the difficulty of obtaining laterite gravel for re-surfacing such paths. The Public Works Department repaired and resurfaced a number of the main roads.

NEW ACQUISITIONS AND PLANTINGS

A valuable acquisition was a plant of *Mussænda philippica* var. *auroræ* sent by Mr. H. G. Keith of Manila to Mr. E. F. Allen of the Department of Agriculture. Mr. Allen kindly allowed the Gardens to keep this plant in order that it might be propagated. It is known in the Philippines as 'Dona Aurora', and, unlike other Mussændas, in which usually only one calyx lobe in each inflorescence is enlarged, it has all the calyx lobes in all the flowers enlarged into creamy white, leaflike structures. Even young plants are free-flowering and Dona Aurora should in the near future be a noteworthy addition to Malayan garden plants.

We are indebted to Mr. Allen also for a number of living plants of native orchids, including one of the Jewel Orchids (*Macodes petola*), which has very beautiful deep velvety green leaves with golden veins.

Eighteen plants new to the Gardens were put out during the year.

PLANTS INWARDS AND OUTWARDS

15,117 plants and 2,787 orchids were sold. Revenue from these sales was $17,528, of which $11,072 came from the sale of orchids. 3,519 plants, 23 orchids and 664 packets of seeds were sent out in exchange or as gifts and 132 plants (including orchids) and 445 packets of seeds were received. The small number of plants received, in comparison with the much larger number sent out, reflects the exchange of several valuable orchids against a much larger number of commoner and less valuable plants.

A limited number of surplus succulents was made available for sale to the public. Local interest in these plants is increasing.

ORCHIDS

Although few new orchid hybrids were flowered during the year, the number of promising seedlings increased considerably. Two new houses were built to accommodate them. These houses are of a simple pattern, being merely a corrugated aluminium roof with Perspex lights on a light wooden framework. Under the benches are watertanks or turf. Such a house is cool, humid and airy, and is very suitable for seedlings and young plants to about 4 inch pot size.

By the end of the year 538 new crosses had been made and there were over 2,000 flasks of seedlings in the laboratory.

Until recently Vacin's formula, which is a mixture of inorganic salts and sugar in *agar-agar* has been used in the flasks. Experiments were begun by Mr. J. L. Pestana using organic substances such as urine and extract of fish in place of the inorganic salts, using as controls seedlings in Vacin's formula. The difference in rate of growth between the two is marked, those on the organic media having grown two or three times as fast as the controls.

M. R. Henderson

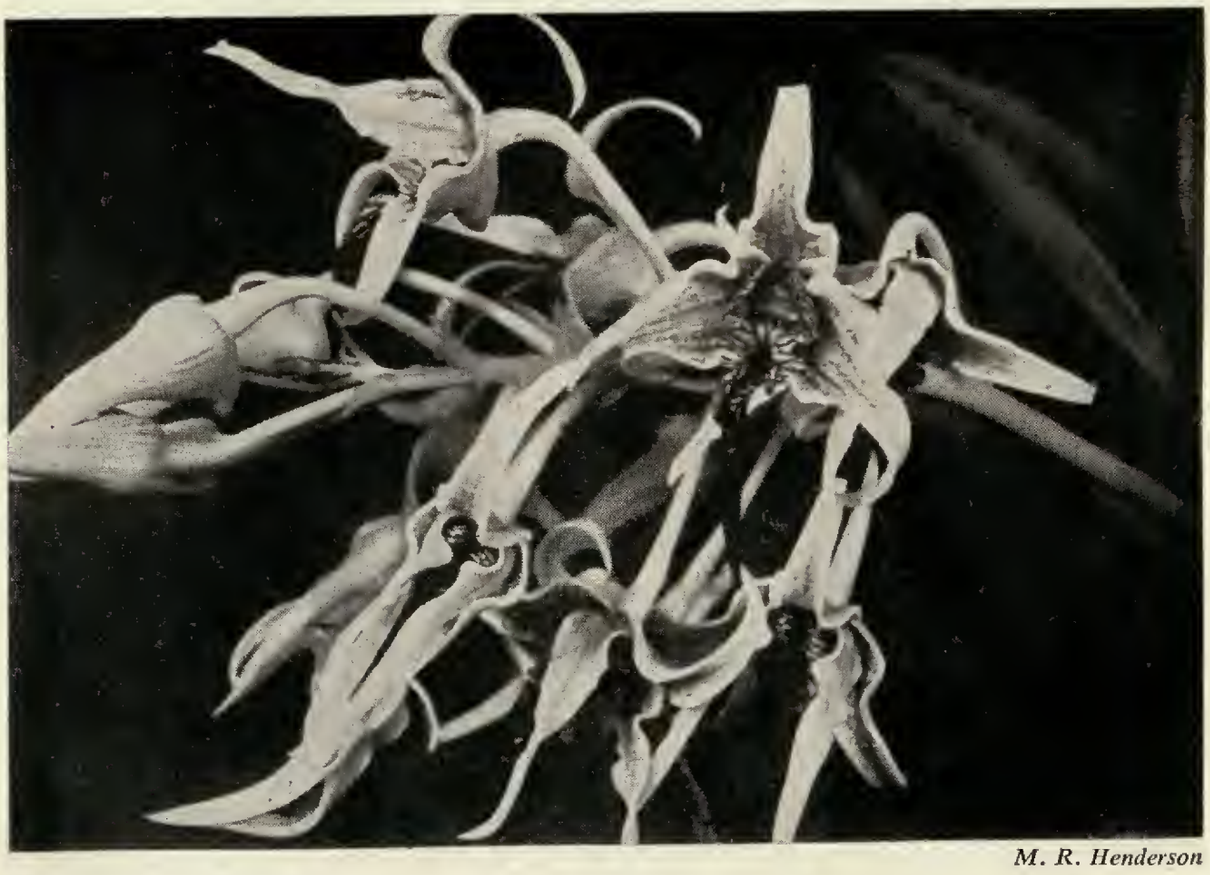
Chonemorpha penangensis, a handsome white-flowered Malayan climber.

M. R. Henderson

Gustavia superba, a small tree from Tropical America with large white and pink flowers.

M. R. Henderson

Agrostophyllum bicuspidatum, a common Malayan orchid cultivated in the Botanic Gardens. The leaves are less than half an inch long.



M. R. Henderson

Dendrobium spectabile, a New Guinea orchid cultivated in the Botanic Gardens. The flowers are about 3 inches across.

M. R. Henderson

The Pergola on Lawn O. The large tree in the background is *Dyera costulata* or Jelutong.

M. R. Henderson

The Waterlilies in the Lake at 8 a.m.

M. R. Henderson

Part of the Frangipanni collection.

M. R. Henderson

Lodoicea seychellarum, the so-called Double Coco-nut, native only in the Seychelles. This plant is fourteen years old.

It was found that in flasks plugged with cotton wool which had been disinfected with picric acid and mercuric chloride, germination was poor and that seedlings transplanted into flasks so plugged tended to turn yellow. It seems possible that the mercuric chloride poisons the culture medium and although these plugs gave almost entire protection against fungus infection, their use has been abandoned.

Mr. Pestana carried out a series of experiments with small seedlings in pots to ascertain their reaction to feeding with artificial manures. The seedlings were between 1 cm. and 8 cm. tall, each set and its controls being uniform in size. They were given weekly application of a mixture supplying nitrogen, phosphorous and potassium, the controls receiving water only. In most cases there was a spectacular increase in height of the seedlings, this being the only dimension measured. The monopodial orchids, such as Vanda and Aranda naturally showed a larger increase than the sympodial ones such as Dendrobium, but inspection of the latter showed that there had been a considerable increase in overall size.

Experiments in a modified method of making beds for such orchids as Vanda, Aranda, etc. have been begun. The usual mixture of half rotted compost and cattle manure is very effective but it breaks down so rapidly that constant renewing and replanting of the beds is necessary. Beds have now been made substituting burnt earth, either newly made, or that discarded from pot plants, for the compost, and these promise well, for the mixture provides the open texture needed for the feeding roots of the orchids and preserves this texture for a much longer time than the compost.

The hybrid Vanda Tan Chay Yan, which was mentioned in last year's report, has fulfilled the promise given by the flowering of the first seedling. It is no exaggeration to say that it is the finest Vanda hybrid yet raised in Singapore and we venture to assert that it will hold its own with any Vanda hybrid from any part of the orchid world. All the seedlings seem to be hardy and free flowering and remarkably uniform in vegetative form and flower colour. They will grow vigorously in burnt earth beds.

New hybrids which flowered for the first time during the year are Dendrobium Gracia Lewis x D.Phalænopsis, which gives promise of being an excellent cross; Dendrobium Ursula x D.undulatum; Vandanthe Ellen Noa x Arachnis Maggie Oei; Vandopsis lissochiloides x Arachnis Maggie Oei; and Arachnis Hookeriana x Aerides odoratum.

A plant of a new Spathoglottis raised by Messrs. A. de Souza and W. de Silva was presented to the Gardens by the growers. It is a cross between Spathoglottis Primson and S.plicata and it is a vigorous plant with a large head of finely coloured flowers. Mr. Lee Kim Hong produced a new hybrid between Dendrobium Schulleri and D.Phalænopsis and gave a plant to the Gardens.

A number of crosses between free flowering Singapore hybrids and hybrids involving *Euanthe Sanderiana* have been made. *Euanthe Sanderiana* is a very fine Philippine orchid, closely related to Vanda. It does not grow well in Singapore and rarely flowers, but its hybrids, many of which have been made in Hawaii, take kindly as a rule to the Singapore climate. Such plants are obtained by exchange. It is hoped that in due course the alliance with Singapore hybrids will result in new and spectacular strains.

The hybrids between Arachnis and Vanda, known as Aranda, are nearly always sterile when selfed or crossed with other groups, which puts a stop

to attempts to breed improved Arandas. However, persistent trials have resulted in a few fertile crosses, of which seedlings are now in flasks. The genera involved are Aranda x Trichoglottis; Aranda x Vanda; Aranda x Vandanthe; Aranda x Renanthera; and Aranda x Arachnis.

Several boxes of cut orchids, contributed by a number of Singapore orchid growers, and by the Botanic Gardens, were sent to London by air for the Coronation. They arrived in perfect condition and were used in the decoration of the Queen's robing room at Westminster Abbey.

A smaller consignment of cut orchids from the Gardens was sent to the Royal Botanic Gardens, Kew, for exhibition at the Royal Horticultural Society's show in London.

VISITORS

A number of distinguished scientists visited the Gardens during the year. Amongst them were H.H. Tunku Yaacob, Member for Agriculture and Forestry, Federation of Malaya; Dr. and Mrs. Julian Huxley; Professor D. A. Webb, Professor of Botany in the University of Dublin; Dr. R. Melville, Royal Botanic Gardens, Kew; Professor B. Lindquist, Director of the Botanic Gardens, Gothenburg, Sweden; Mrs. Raymond Greene, botanist and artist from America; Mr. A. B. Walton, Conservator of Forests, North Borneo, and Mr. H. D. Ingle of C.S.I.R.O., Australia.

GOVERNMENT HOUSE DOMAIN

The grounds of the Domain were kept in good order throughout the year, partly due to the use of a new Dennis motor mower and an extra Allen motor scythe, which enabled most of the outlying parts of the Domain to come under close cultivation. Only small areas of undesirable thickets and rough growth remain to be dealt with.

All Canna beds were replanted twice during the year. The old Juniperus and Cypress trees alongside the 'in' and 'out' drives to Government House, which were long past their best, were removed and replaced by sixteen *Stenolobium stans*. A long section of the Hibiscus hedge bordering the 'out' drive, which had become old and untidy, was removed and replaced by a Cordia hedge, which in four months was full grown. Two very tall Royal palms by the path leading to the New Garden were taken out in accordance with the planting scheme for this area, begun two years ago. A large plant of *Bignonia magnifica* on the slope above the New Garden was replaced by eight Bougainvillea Singapore Beauty. A large bed of *Ixora javanica* was removed from the top of the slope above the guardroom and seven single beds of *Bougainvillea Poultoni* (a recent introduction to Singapore) and *Calliandra emarginata* put in its place. The Clove trees alongside the 'out' drive, which were beginning to lose their original compact shape, were heavily mulched with compost and the turf below them was renewed.

There has been a marked improvement in the growth of the orchid plants since their removal to the new nursery and an increased supply of cut orchids for Government House is now available.

Burnt earth for the large number of pot plants maintained was made about once a month. Sterameal was largely used as manure for these plants, with satisfactory results. Large quantities of compost were made, the chief constituent of it being spent hops, which were collected regularly from the local breweries.

The Domain competed in the 1953 Flower Show, exhibiting pot plants and cut flower arrangements and being awarded several prizes. Money prizes so gained are distributed to the gardeners who grew the plants or arranged the cut flower exhibits.

OUTSIDE WORK

The usual contact with the City Council Parks Department was maintained, with exchanges of plants.

Planting plans were drawn up for various building schemes and other public works, such as the Fort Canning Cemetery Park, the new Nurses Quarters at the General Hospital, etc. Welfare and charitable organizations were helped with advice and supply of plants. Many visits were paid to examine trees thought to be unsafe or in need of pruning; Mr. Addison paid a visit to Malacca to examine and report on roadside trees there, and was able to convince the authorities that several trees which they had thought dangerous could be preserved.

By kind permission of "The London Evening News"

Mr. H. N. Ridley, C.M.G., F.R.S., Director of Singapore Botanic Gardens 1888–1912, on his ninety-ninth birthday—10th December, 1954

COLONY OF SINGAPORE

ANNUAL REPORT OF THE BOTANIC GARDENS DEPARTMENT FOR 1954

BY

J. W. PURSEGLOVE
Director, Botanic Gardens
Singapore

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1955

I. STAFF

MR. M. R. HENDERSON, Director of Botanic Gardens, 1949–54, who had been on the staff since 1924, went on leave prior to his retirement on the 6th June. Mr. J. W. Ewart, Curator, acted as Director from that date until the arrival of the new Director, Mr. J. W. Purseglove, on the 23rd August, on transfer from the Uganda Agricultural Department. Professor R. E. Holttum retired from the Chair of Botany at the University of Malaya and left the Colony in October. Dr. Holttum was appointed Assistant Director of Botanic Gardens in 1922 and was Director from 1925–49. The University conferred upon him the honorary degree of D.Sc. before his departure. He has retired to Kew where he will continue his taxonomic studies of Malayan plants. I am happy to record that Mr. H. N. Ridley, C.M.G., F.R.S., Director 1888–1912, celebrated his 99th birthday in his home at Kew on the 10th December, and that Mr. I. H. Burkill, Director 1912–25, now in his 85th year, is still actively engaged on botanical research. Thus, all four past Directors, beginning from 1888, are alive, which must be a record for any department in the Colonial Service.

2. Mr. H. M. Burkill, son of Mr. I. H. Burkill, was appointed Assistant Director and arrived in Singapore on the 14th December. With the appointment of an Agricultural Officer, Singapore, Mr. Ewart ceased to act part-time in that capacity and resumed full-time his post of Curator of Gardens. He proceeded on six weeks' annual leave on 4th December. Mr. G. H. Addison, Curator, Parks, was on vacation leave from 6th February until 14th September. Mr. J. Sinclair, Curator of the Herbarium, and Dr. C. X. Furtado, Assistant Botanist, were on duty throughout the year. Thus by the end of the year the Gardens had its full complement of senior staff for the first time since before the war. The list of the staff is given in Appendix *I*.

3. Mr. A. G. Alphonso, Horticultural Assistant, left Singapore on 27th August to attend a two years' course of training at the Royal Botanic Gardens, Kew.

4. The Director was Chairman of the Plant Protection Conference for South-East Asia and the Pacific Region convened by the Food and Agricultural Organisation of the United Nations and held at Singapore from 13th to 17th December. The Conference was attended by twenty-two delegates and observers representing ten Governments. A Draft Plant Protection Agreement for the region as a whole was drawn up, which, when ratified, should prevent the entry of destructive diseases and pests, and more especially the South American Leaf Blight of rubber (*Dothidella ulei*).

5. At the International Botanical Congress held in Paris in July, Mr. Purseglove was elected to the Committee of L'Association Internationale des Jardins Botaniques.

II. LABOUR

6. The average number of labourers employed per month in the Gardens was 81 and at Government House Domain 56. Health and attendance were good throughout the year. All labourers received increases in salary recommended by the Ritson Salaries Commission, which were retrospective from 16th June, 1953. The average daily salary of a daily-rated labourer or

gardener is now $3.20, plus an allowance of $1, a total of $4.20. Salary scales increased in the various grades of technical staff to a maximum of $7.75 per day for a mechanic, Grade II.

7. It is with regret that I record the death of Mr. Cheong Swee San, who served the Gardens faithfully for about thirty years, and who was for many years responsible for the display of potted plants. He collapsed at work on the 28th October and died about an hour later.

8. During the year five men from the Singapore Anti-Tuberculosis Association and the Rehabilitation Section of the Labour Department spent several months in the Gardens as gardener trainees.

III. METEOROLOGICAL

9. The total rainfall for the year of 117 inches was above the average of 104.35 inches for the last ten years. It was due largely to the phenomenal and almost continuous rain which fell in the second week of December. The total rainfall for December was 26.77 inches. This caused serious flooding in parts of Singapore, but did little serious damage in the Gardens. The highest shade temperature recorded during the year was 90° F. and the lowest 70° F.; the mean maximum temperature being 86° F. and the mean minimum 74.4° F. The average temperature at 9.30 a.m. was 80.5° F. and the mean relative humidity was 84.1 per cent. The meteorological records for the year are given in the Appendix *II*.

10. A freak storm with a series of small whirlwinds struck the Gardens on the afternoon of 12th April and did severe damage in several patches, but had no well-defined path. The general labourers spent the rest of April and the greater part of May in clearing away the debris.

IV. BUILDINGS AND ROADS

11. The redecorating of the offices and herbarium was begun towards the end of the year and has made a vast improvement. The herbarium is a two-storey building and the upper storey consisted of a gallery round the periphery. A floor has now been added thus making room for more herbarium cases. The fitting of glass-tiles in the roof eaves above the windows has dispersed the stygian gloom, so that electric lights are no longer necessary throughout the whole day. Work began on the new single-storey building behind the herbarium to house the spirit collection of plants, but which will be used temporarily to house the library. All the above work was done on contract from the Public Works Department and I am most grateful to that Department for their great help and co-operation in this matter, which has done so much to improve the appearance of the buildings.

12. Part of the south-end of the Plant House was reconstructed. The benches were demolished and replaced by beds retained by brick or coral walls. The old pipe-and-wire-netting arched pergolas were replaced by a flat-topped pergola on *tembusu* posts. A new orchid seedling house, 36 × 12 feet, was built on Lawn X. It was of a similar construction to the houses built in 1953 and consisted of a corrugated aluminium roof with Perspex lights on a wooden frame-work. A somewhat derelict plant house near the potting shed was demolished by a large *Alstonia scholaris*, which fell during

the storm of 12th April. It will be rebuilt in 1955. In December Lawns P and R were enclosed with a wire-mesh security fence with a double barbed-wire apron, prior to the transfer of the orchid collection from around the Director's house.

13. No work on roads, paths and drains was done by the Public Works Department during the year. Gardens' staff closed and turfed the paths on the Sun-dial and Pergola Terraces thus reducing the cost of maintenance and also improving the general appearance.

14. From the 1st May the Office Ring Road, the only road which is now generally open to vehicles, was restricted to one-way traffic with parking on the left of the road only. This has reduced traffic conjestion considerably, particularly at the weekends. Cyclists are still a nuisance and new by-laws to control them and other offenders are urgently wanted. No new by-laws have been made since 1922 and, although it is possible to prevent horses being grazed on the lawns, it is found impossible to control some other offenders.

V. LIBRARY

15. Towards the end of the year the Library, containing an extensive collection of botanical books, many of which are rare and valuable, was found to be heavily infested with boring beetles. Many of the books have since been hand-poisoned and all the shelves were removed from the office building where the clerical staff worked in one conjested corner. This has permitted re-organisation of the office, and a new building, built for the spirit collection, will be air-conditioned and used temporarily to house the library until such time as a new library can be built.

16. Many current periodicals are received in exchange for the *Gardens' Bulletin* and *Annual Reports*, and those for which subscriptions are paid were reviewed and amended. An effort is now being made not to duplicate unduly with the University of Malaya's Library, except for those journals which are in frequent use by both institutions. A few new books were added towards the end of the year. There are very considerable arrears of binding to be done.

17. Mr. G. A. C. Lopez, Library Assistant, resigned at the end of the year.

VI. BOTANICAL WORK AND HERBARIUM

(i) COLLECTING

18. Mr. Sinclair continued collecting in Singapore and accessible areas of Johore during the year. Despite the extensive collecting that has been done in Singapore over a period of many years, several new records were obtained, the most interesting being *Halorrhagis chinensis*, which from its situation is probably native, but had not previously been collected in Malaya. In an area of swamp forest in the water-catchment area, he found a tree fern, *Cyathea glabra*, and a waterlily, *Barclaya motleyi*, which had not been seen on the Island for many years.

19. By kind permission of the R.N.V.R. authorities, Mr. Sinclair made a short trip on the training ship *Panglima* to collect on Pulau Tinggi in May. He also made several visits to Sungei Tiram in Johore, but had to give them up when it became a centre of bandit activity. He again spent three weeks

collecting in Trengganu, this time in November, and collected 135 numbers, of which 60 were new records for Trengganu and 14 appear to be new species, which will be described later. I would like to thank the State Forest Officer, Mr. Fyfe, and the District Forest Officer, 'Che Ibrahim, who accompanied him and provided transport. Mr. Sinclair returned by way of Kota Bahru in Kelantan.

(ii) EXCHANGE OF HERBARIUM SPECIMENS

20. During the year 3,735 sheets of specimens were mounted and laid in the Herbarium, compared with the 1,636 in 1953. This increase was due in part to the 2,732 duplicates received from the Herbaria of Bogor, the Forest Departments of North Borneo, New Guinea and Sarawak, the Forest Research Institute at Kepong, Kew, Leiden, Dehra Dun and Manila. A large collection of fresh water swamp species gathered by Mr. J. A. R. Anderson of the Sarawak Forest Department was particularly valuable, as many of these were not represented in the Singapore Herbarium. Our grateful thanks are due to all those who donated specimens.

21. We sent out 3,321 exchange duplicates, compared with only 88 in 1953. These were despatched to the Herbaria of Kew, British Museum, Edinburgh, Leiden, Bogor, Paris, Manila, Dehra Dun, Forest Department of North Borneo, Forest Research Institute at Kepong, and Agricultural Department at Bangkok.

22. There was also an increase in the number of specimens sent on loan to botanists working on the *Flora Malesiana*, mainly to Leiden, Bogor and Kew, the number being 3,097 as compared with 2,563 in 1953. A number of previous loans were returned with the plant names checked and revised and many unnamed specimens were determined. This will be of great assistance to future botanists studying our collections, as the names in these families have now been brought up-to-date.

(iii) TAXONOMIC RESEARCH

23. Mr. Sinclair, when not engaged on routine work of identification, etc., continued his revision of Myristicaceæ (Nutmeg Family). He obtained loans of specimens from Kew, Calcutta, Dehra Dun, Lae, Leiden, Utrecht, Florence and Breslau, which helped him to clear up various points of the nomenclature. Unfortunately many of the types of the New Guinea species were destroyed in Berlin during the war, thus adding to the difficulty of the work.

24. Dr. Furtado continued his investigation of palms, revising the genus *Calamus*. It is a particularly difficult genus, as specimens preserved in herbaria are often imperfect, due to the difficulty of collecting large rattans which climb to the top of tall trees and are firmly fixed by reflexed hooks. Often only the tips of the leaves are collected and the more difficult basal parts and troublesome spiny sheaths are neglected. Furthermore, the parts required for exact identification are many, and unless all portions are carefully labelled at the time of collection there is a danger of mixing them during drying. In fact one rattan specimen sent to Singapore was found on examination to consist of three distinct genera.

(iv) WEEKLY EXHIBIT OF WILD FLOWERS

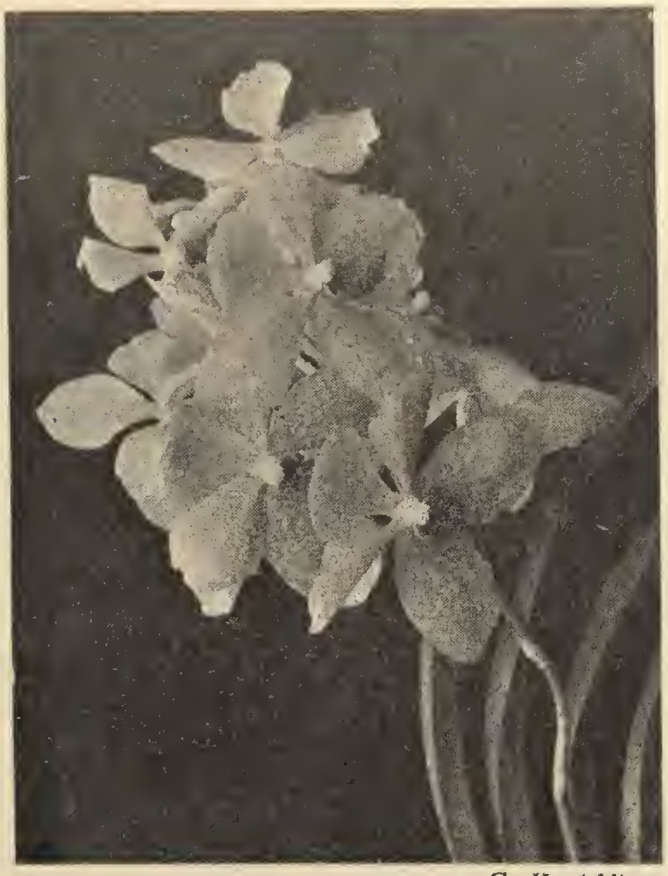
25. Beginning in November a small weekly exhibit of seven common wild plants, which can be found growing in Singapore, was staged in the Plant House. Wherever possible the previous week's exhibit was maintained

J. W. Purseglove

Dendrobium Hybrids growing in hanging pots under light shade

J. W. Purseglove

Tacca cristata Jack, an indigenous Malayan plant



G. H. Addison

Vandanthe rothschildiana, a variety of which was awarded F.C.C. at the R.H.S. Chelsea Flower Show, 1954

G. H. Addison

Dendrobium John Nauen, a hybrid of *D. formosa* and *D. takahashii* named after the late Mr. Nauen, Curator of Gardens, 1935–42

for reference. By this means it is hoped that the general public, more especially teachers and students, will take a more lively interest in the plants which grow around them. The exhibit has proved very popular, and is visited by large numbers of people. The plants are labelled with their scientific, English and Malay names, the family and brief notes are given on each plant.

VII. HORTICULTURAL WORK

(i) GENERAL

26. Routine planting, as well as the general maintenance of the Gardens, was carried out during the year, and a few of these many operations are mentioned: Following the turfing of the paths of the Sun-dial Terrace, borders were made along the outer edge and planted with standard Hibiscus and Gerberas. A bed of *Euphorbia pulcherrima* (Poinsettia) was particularly successful; good drainage provided by 2 feet of rubble in the bottom of the bed and a 4-inch drainage pipe being largely responsible, together with a monthly application of sulphate of ammonia at the rate of 2 oz. per square yard. The latter undoubtedly intensifies the red colour of the bracts. On the poor, heavy clay soils in the Gardens, good drainage and adequate feeding are essential for the successful growth and flowering of most introduced species of trees, shrubs and herbs. Regular supplies of cattle manure from the Animal Quarantine Station and spent-hops from the Malayan Breweries were obtained during the year. Large quantities of compost were made in the Gardens, while Sterameal has proved valuable as a general-purpose, organic fertilizer. Some clearing and replanting was done in the Dell and unwanted tree seedlings removed from the Arboretum. The thicket between the Director's house and Tyersall Avenue, which had encroached considerably on Lawn T, was cut back towards the end of the year and several years' accumulation of rubbish was removed. One man was employed full time throughout the year removing weeds from the lake.

(ii) ORCHIDS

27. The outstanding event of the year in orchid circles was the success of Singapore-grown orchids at the Chelsea Flower Show of the Royal Horticultural Society in May, where they were exhibited by Mrs. Gracia Lewis. The exhibit as a whole was awarded the Lindley Medal and two of the hybrids received the highest awards of the Royal Horticultural Society for individual flowers, namely First Class Certificates. This was an outstanding achievement, as only three First Class Certificates were awarded in the entire show. The third went to a carnation. The Singapore orchids receiving the awards were Vanda Tan Chay Yan, raised in the Botanic Gardens from a cross made by Mr. Tan Hoon Siang, and *Vandanthe rothschildiana*, from Mr. D. C. Doo's collection in Singapore. The latter orchid was particularly admired by the Queen Mother. Vanda Tan Chay Yan, which is illustrated between pages 6 and 7, has fulfilled its early promise and is considered one of the best *Vanda* hybrids produced anywhere in the world. Our seedlings of this hybrid flower almost continuously producing a succession of fine inflorescences. We are now using it extensively for further crossing and have crossed it with *Vandanthe rothschildiana* and other good hybrids such as V. Ellen Noa, *V. tatzeri* and *Vanda hertziana*, and now have seedlings of these crosses in the flask stage.

28. During the year a few new hybrids flowered for the first time. They were Aranda Abdul Kadir (Vanda Kapoho x Arachnis Ishbel), Cypripedium Pygmy (*C. concolor* x *C. barbatum*), Dendrobium Max Lewis (D. Bali x D. Louis Bleriot), D. Bali (selfed), D. Ng Tar Kuay (D. Medusa x D. Curlylocks), *Vanda dearei* x *V. merrillii*, *V. dearei* x V. Kapoho, Vandachnis Premier (*Arachnis flos-aeris* x *Vandopsis lissochiloides*).

29. The number of orchid seedlings increased considerably and the four orchid seedling houses, of which one was built during the year, with aluminium and Perspex roofing and open sides, have proved very effective and the young plants have shown excellent growth. Further houses are now required to house the ever-increasing number of seedlings. During the year 144 crosses were made and there were over 1,500 flasks of seedlings in the laboratory, with over 50 seedlings per flask. As stated in last year's report, flasks plugged with cotton wool disinfected with mercuric chloride and picric acid gave a poor germination and caused yellowing of the seedlings. These disinfectants have now been replaced with copper sulphate, which shows no harmful effects. The use of Vacin's formula in the flasks, which is a mixture of inorganic salts and sugar in *agar-agar* was continued. The use of urine and extract of decomposed fish was discontinued, as the odour was somewhat obnoxious to the laboratory staff. Mr. J. L. Pestana carried out an experiment using Sterameal, fish manure and inorganic manures on seedlings which had been potted up and placed in the seedling house. It was found that the organic manures resulted in the growth of a thick mat of algae on the benches and the bottoms of the pots, which eventually blocked the drainage holes, thus causing water-logging and the eventual death of the young plants. This was overcome by placing the pots in sand to facilitate drainage.

(iii) SUCCULENTS

30. The succulent collection was added to during the year by the exchange of seeds with other institutions and we now have over 300 species in cultivation. There is an increasing interest by the general public in growing succulents locally and it was found impossible to meet all the demands for the purchase of these plants.

(iv) PLANT EXCHANGE AND SALES

31. The Gardens continued to sell plants to the general public and there was a considerable increase in the number sold, namely 24,057 compared with 15,117 in 1953. In addition 2,740 orchid plants and seedlings were sold. Numerous requests were received from overseas and these were met as far as possible. It is the policy of the Gardens to grow for sale only those trees, shrubs and herbaceous plants which cannot be obtained from the local nurseries. In providing this service, undoubtedly the standard of local horticulture is raised and the variety of plants grown in local gardens is extended. The total revenue from the sale of plants was $19,416, an increase of $1,888 over the 1953 sales. Of the total figure, $11,920 came from the sale of orchids. We supplied 9,690 plants free to schools and other government institutions.

32. In addition to the sales, it has been the custom of the Gardens to exchange seeds and plants with other botanical institutions. The requests for such exchanges is increasing. 179 plants and 878 packets of seeds were sent out, while we received 154 plants and 489 packets of seeds. This disparity in numbers is not surprising, as the number of institutions which can supply

The pictures on this page are of tropical hybrid orchids grown in Singapore. It is common for amateurs to effect their own crosses and in many cases to hand over the seeds they produce to the Botanic Gardens for germination.

The top picture is of *Vanda Tan Chay Yan* (*Vanda Josephine van Brero* × *Vanda dearei*) which was awarded a First Class Certificate at the Royal Horticultural Society's show at Chelsea in 1954.

The middle picture shows *Vanda Prolific* (*Vanda Nam Kee* × *Vanda Singapore*), a very free flowering hybrid. It first flowered in September in 1949, two and a half years after the seed was sown—four years is an average for Singapore hybrids.

C. H. Addison

The bottom picture is of *Vanda Kapoho* (*Vanda lamellata* var *boxallii* × *Vanda tricolor*) raised simultaneously in Singapore and Hawaii. It is a free flowering hybrid with an attractive scent. Orchids have been raised in Singapore since 1928 and are a regular feature of the Singapore Annual Flower Show.

plants which will grow in Singapore is limited, whereas Botanic Gardens in temperate regions can grow tropical plants in their glass-houses and the number of tropical Botanic Gardens is small. Furthermore, we have always had a high reputation for sending out seeds in good condition and well packed. This friendly exchange is valuable and helps to maintain contact with a great number of Botanic Gardens and institutions throughout the world, who help us in many ways.

33. A further service provided by the Gardens is the loaning of potted foliage plants for Government and certain charity functions in Singapore, and during the year 4,201 plants were loaned for this purpose.

VIII. GOVERNMENT HOUSE DOMAIN

34. The grounds of the Domain were kept in good condition except for a period in the middle of the year when most of the mowers were out of order at one time. The Allen motor scythes were found invaluable in keeping down the rough grass in the outlying parts of the Domain.

35. The major improvement during the year was the reconstruction of the Court Garden at Government House. The tree screen was removed and replaced by a *Cordia* hedge, thus permitting the entry of more light and air. The pathways were redesigned and laid with crazy paving by the Public Works Department, while new beds were planned and planted with Cannas, *Pentas, Galphimia, Crossandra, Bouganvillia poultoni* and *Calliandra surinamensis.*

36. The triangular section on the left of the road leading to the office was also replanned. Three tall trees and some ancient Hibiscus standards were removed. A new border was planted with fairly tall shrubs such as *Stenolobium stans* and *Jatropha pandurifolia,* interspersed with *Lantana* and *Crossandra,* which should be very colourful.

37. The very large *Lagerstræmia* on the top of the slope above the Guard Room in Government House grounds, which became poor and very unsightly, was pruned severely and cut back to a height of 12 feet, and has since made an excellent recovery. The two pergolas of *Mucuna bennettii* (New Guinea Creeper) have grown well and it is of interest to record that the younger plant which has never been pruned flowered very well, while the plant which was pruned in 1953 has not flowered since that date. The *Stenolobium stans* on either side of the main drive flowered six times during the year. With the application of Sterameal, it has been found that the Cannas may be planted once a year instead of twice as formerly. The fine *Araucaria cunninghamiana* in the Colonial Secretary's garden fell during a high wind and was found to be badly damaged by white ants, a common failing with this species. Frequent applications of organic manures, such as compost made from spent-hops and garden refuse, and also with cattle and horse manure, is essential for good growth and flowering in the Domain.

38. About 2,500 pot plants have to be maintained in order to supply the houses of the Domain twice weekly. Burnt earth is made once per month for potting. The heavy rains in December did much damage to the plants, particularly the younger seedlings in the potting yard. Vegetables and orchids were supplied regularly from the nursery.

39. Plants from the Domain were again entered in the Singapore Flower Show.

IX. ADVISORY WORK

40. The Curators, as is customary, advised various Government Departments on the layout of grounds, road-verges, etc., and the Gardens provided planting material in many cases. Many other institutions, firms and people also asked for advice; their requests were dealt with in the office or, if circumstances warranted it, visits were made. The major new tree planting scheme was on the new Changi Coast Road and the Tanah Merah Besar Road. The latter was planted with *Gardenia carinata* and *Lagerstræmia flos-reginæ*. Some 150 shrubs and trees were provided for the new turnabouts on the Bukit Timah Road. The usual contact was maintained with the City Council Parks Department, and planting material was exchanged.

41. The Department supervised the transplanting of a *Ficus religiosa* from the main runway of the new International Airport at Paya Lebar. This holy tree, which had a shrine at its base, is said to have been brought as a cutting from a tree in Ceylon, which in turn was a scion of the tree at Magadha under which Buddha became incarnate. The tree at Paya Lebar was over 70 feet high and was cut back to about 30 feet. The tree with a ball of earth, weighing altogether about 25 tons, was transported to a site half a mile away and replanted. It seems probable that the tree will establish itself satisfactorily on the new site.

X. NATURE RESERVES

42. Prior to 1936 most of the present Nature Reserves were Forest Reserves under the old Forest Ordinance, but in that year it was decided that they were no longer worth maintaining for production. In July 1937, the Botanic Gardens took over the maintenance of certain reserves, namely, Bukit Timah, Pandan and Kranji and in 1938 the Director of the Botanic Gardens was gazetted Conservator of Forests, a post which had originally been held by Mr. Ridley. In 1951 the Nature Reserves Ordinance was enacted and the Board of Management of one *ex-officio* and six nominated trustees was formed to administer the Reserves. The Director of Gardens is the *ex-officio* Chairman of the Board. At this time the Municipal Catchment Area and the cliff-face at Labrador (Pasir Panjang Reserve) were added, making a total of over 9,000 acres of Nature Reserves in the Colony, which are thus "dedicated, set aside and reserved for the purpose of the propagation, protection and preservation of the indigenous fauna and flora of the Colony and for the preservation of objects and places of æsthetic, historical or scientific interest".

43. Bukit Timah was one of the first Forest Reserves made in Singapore, shortly after Cantley's Report of 1883, and is one of the few remaining areas of good primary rain forest left on the Island. It has been a botanical collecting-ground for more than a century and from it has been obtained the first known specimens of many species of Malayan plants. Apart from the quarries which disfigure the lower slopes and which are outside the boundary of the reserve, Bukit Timah has been little altered since the earliest days and has been little exploited for timber. At present it is just big enough to maintain its own internal climate and to be self-maintaining in regard to plant species. Any further opening up of the area would be disastrous. The other Nature Reserves contain areas of fresh-water and mangrove-swamp forests, while much of the catchment area is secondary forest and scrub (*belukar*).

44. In the Bukit Timah and Kranji Reserves, where staff has been employed for many years, the reserves have remained inviolate. In other reserves where staff is not available, some clandestine cutting goes on. Prior to 1954 there had been only one meeting of the trustees, but during the year meetings were held on the 26th February and 15th November. It is now proposed that meetings should be held quarterly.

XI. SINGAPORE GARDENING SOCIETY

45. The Department was largely responsible for the formation of the Singapore Gardening Society in 1936, and Professor Holttum was President for many years. Mr. Ewart, the Curator of Gardens, is President for the year 1954/55. Meetings are held monthly, often in the Botanic Gardens, where demonstrations of practical horticulture are given. The Society has 238 members and is flourishing. The average attendance at meetings was 64. It staged its sixth post-war Flower Show on 2nd–4th April, which was held at the Happy World Stadium. It was most successful, with 536 entries, and a high standard of exhibits was maintained. Mr. Ewart was show-manager and Mr. Alphonso was assistant manager. A large non-competitive group of orchids was exhibited by the Gardens, while tulips, hyacinths and lilacs from Holland and orchids from England were displayed in a cool house erected for the purpose.

XII. VISITORS

46. Professor Dr. C. G. G. J. van Steenis, General Editor of the *Flora Malesiana*, visited the Gardens in January and was accompanied by Mr. Henderson on a tour of some of the interesting botanical areas in the Federation of Malaya. Other notable visitors included Sir Roland Robinson, M.P., all the delegates and observers attending the F.A.O. Plant Protection Conference held in Singapore in December, and Mr. C. V. Jacks, Director of the Commonwealth Bureau of Soil Science.

XIII. PUBLICATIONS

47. The sixth small volume in the series *Malayan Garden Plants* was published during the year, while volume II was reprinted. The *Gardens' Bulletin*, Vol. XIV, Part 2, was handed in for publication early in the year, but did not come out until February 1955. Messrs. Addison and Henderson continued their work on the illustrated book of *Malayan Orchid Hybrids*, which it is hoped will be published in 1955.

48. The articles and other works that were published during the year were as follows:—

ADDISON, G. H.; HENDERSON, M. R.—New Hybrids from Singapore. *Orchid Journal III*, 4, 1954.

HENDERSON, M. R.—*Malayan Wild Flowers—Monocotyledons*. Malayan Nature Society, Kuala Lumpur.

HENDERSON, M. R.—*Malayan Garden Plants, Vol. VI—Ten Herbaceous Plants*—Government Printer, Singapore.

APPENDIX I

STAFF OF BOTANIC GARDENS, 1954

DIVISIONS I–III

Appointment	*Name*	*Remarks*
Director	M. R. Henderson, F.L.S. ...	1-1-54–6-6-54
	J. W. Purseglove, B.Sc., A.I.C.T.A., F.L.S.	From 23-8-54
Assistant Director ...	H. M. Burkill, M.A., F.L.S. ...	From 14-12-54
Curator of Herbarium ...	J. Sinclair, B.Sc.	
Assistant Botanist ...	C. X. Furtado, D.Sc.	
Curators (2) ...	J. W. Ewart	Acting Director 7-6-54–22-8-54
	G. H. Addison	On leave 6-2-54–14-9-54
Laboratory Assistant (Special Grade) ...	J. L. Pestana	
Horticultural Assistant ...	A. G. Alphonso	Proceeded for training in U.K. 23-8-54
Herbarium and Museum Assistant ...	Haji Mohd. Nur bin Mohd. Ghous	
Laboratory Assistant ...	Bajuri bin Sappan	
Artist	Juraimi bin Samsuri	
Clerks	Abdul Wahab bin Abdul Hamid ...	Until 21-9-54
	Loh Fon Sen	From 20-9-54
	K. Veerappan	
	Miss Celine Schelkis	
Despatch Clerk ...	R. Raphael	
Stenographer ...	Miss Diana Foo	From 5-11-54
Library Assistant ...	G. A. C. Lopez	
Junior Horticultural Assistant	Abdul Aziz bin Pakiri	
Junior Horticultural Assistant (Govt. House Domain)	Wong Siew Hang	
Storekeeper ...	Ismail bin Ahmad	

APPENDIX II

METEOROLOGICAL RECORDS

BOTANIC GARDENS, SINGAPORE 1954

Readings Daily at 2.00 hrs. G.M.T. = 9.30 a.m. Local Time

Month	Mean Temp. at 9.30 a.m.	Highest Max. Temp.	Lowest Min. Temp.	Mean Max. Temp.	Mean Min. Temp.	Mean Rel. Humidity	Rainfall	Average 1944–54	Highest Rainfall in 24 hrs.	Number of days
	°F	°F	°F	°F	°F	per cent	in.	in.	in.	
January	79.5	89.0	72.0	83.9	73.9	86.0	7.62	9.43	1.10	21
February	80.6	91.0	72.0	86.9	74.0	82.1	9.40	8.85	3.68	19
March	80.9	92.0	72.5	87.1	74.4	82.0	5.81	9.72	1.75	14
April	82.4	92.5	73.5	85.8	75.5	82.8	6.89	9.94	1.28	22
May	82.1	93.0	72.5	88.2	75.7	84.7	5.41	7.40	1.31	13
June	80.6	92.0	71.0	86.6	74.9	85.1	13.04	6.52	4.35	17
July	80.3	90.5	72.5	85.5	74.6	85.0	7.49	6.69	1.97	19
August	80.5	90.0	71.5	86.4	74.8	84.9	8.87	6.93	2.10	19
September	80.9	90.0	72.5	85.9	75.1	82.3	5.64	7.95	1.80	18
October	79.9	89.0	70.0	85.7	73.7	84.8	10.75	8.25	3.00	24
November	79.9	92.0	71.5	86.4	73.8	83.7	9.31	10.49	1.82	25
December	78.9	89.0	71.5	84.1	73.1	85.7	26.77	12.18	5.65	24
Total or Mean ..	80.5	93.0	70.0	86.0	74.4	84.1	117.00	104.35	5.65	235

COLONY OF SINGAPORE

ANNUAL REPORT OF THE BOTANIC GARDENS DEPARTMENT FOR 1955

BY

J. W. PURSEGLOVE
Director, Botanic Gardens
Singapore

PRINTED AT THE GOVERNMENT PRINTING OFFICE, SINGAPORE.
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1956

CONTENTS

		Paragraphs
I.	General	1–3
II.	Staff	4–11
III.	Meteorological	12–13
IV.	Botanical Work and Herbarium	
	(i) Collecting	14–20
	(ii) Exchange and Loan of Herbarium Material	21–24
	(iii) Taxonomic Research	25
	(iv) Weekly Exhibits of Wild Plants	26
V.	Horticultural Work	
	(i) General	27–32
	(ii) Orchids	33–37
	(iii) Succulents	38
	(iv) Plant Sales and Exchange	39–41
VI.	Advisory Work	42–45
VII.	The Ridley Centenary	46–50
VIII.	Labour	51
IX.	Buildings and Roads	52–55
X.	Library	56–59
XI.	Band Concerts	60–61
XII.	Gardens' By-laws	62
XIII.	Gardens' Trainees	63
XIV.	Government House Domain	64–66
XV.	Kranji War Cemetery	67
XVI.	Nature Reserves	68–70
XVII.	Singapore Gardening Society	71
XVIII.	Visitors	72–74
XIX.	Publications	75–77

I. GENERAL

THE BOTANIC GARDENS had its full complement of senior staff for the first time for many years. It was thus possible to extend the work of the Department and good progress was made in several branches, more especially in increased plant collecting and in improvements to the Gardens. Even so, there are many pressing botanical problems, which cannot be tackled with the limited staff. Consideration is therefore being given to schemes designed to attract research workers from Britain and elsewhere to Singapore for one or two years to carry out botanical research in their specialized fields, with the object of increasing our output of research, and obtaining knowledge which would be of great value for the tropics as a whole; and of familiarising workers from temperate countries with tropical botany and stimulating their interests in our problems.

2. The great event of the year as far as the Botanic Gardens were concerned was the celebration of Mr. H. N. Ridley's hundredth birthday on the 10th December, 1955. Mr. Ridley was Director of the Botanic Gardens from 1888 until 1912 and was largely responsible for the founding of Malaya's rubber industry. An exhibition was staged at the Gardens to mark the occasion. Details are given in paras. 43-47 below.

3. Mr. E. J. H. Corner, Assistant Director of the Singapore Botanic Gardens, 1929–1946, and now Lecturer in Botany at Cambridge University, was elected a Fellow of the Royal Society in March. He thus becomes the third person connected with the Gardens to receive this honour. The others are Sir Stamford Raffles, who founded the first Singapore Botanic Gardens in 1822 and Mr. Ridley.

II. STAFF

4. All Division I officers were on duty throughout the year with the exception of Mr. Ewart, who returned from six weeks' vacation leave in New Zealand on the 18th January. Dr. C. X. Furtado, a re-employed pensioner, continued in his post of Assistant Botanist. Attempts to fill the post locally failed, as no one with the requisite qualifications was forthcoming. Dr. Anne Johnson worked temporarily as part-time Librarian from 1st February, 1955 to 15th September, 1955. Mr. H. M. Burkill, Assistant Director, acted as Director during my absence collecting in Sarawak in September.

5. Mr. A. G. Alphonso, Horticultural Assistant, spent the year at the Royal Botanic Gardens at Kew, continuing his course of training.

6. The British Empire Medal was conferred by Her Majesty the QUEEN in the Birthday Honours on Haji Mohamed Nur bin Mohamed Ghous, Herbarium Assistant. Haji Mohamed Nur has been on the staff of the Botanic Gardens since 1913, and as a boy helped Mr. Ridley with his now-famous rubber tapping experiments.

7. Ahmad bin Hassan, the oldest member of the staff, completed 54 years of service. He was first employed by Mr. Ridley as a Plant Collector in 1901 and accompanied Mr. Ridley on many of his historic expeditions of long ago, which added so much to our knowledge of the country's botany. 'Che Ahmad now spends his time collecting seeds for despatch to botanical institutions throughout the world. His great knowledge of living plants ensures that only authentic seeds are sent out and is also most useful to members of the staff on local excursions.

8. The Director acted as Chairman of the Committee on Animal and Vegetable Life and Resources of the Pan-Malayan Scientific Advisory Council during the second half of the year.

9. A list of the Divisions I to III officers is given in the Appendix I.

III. METEOROLOGICAL

10. The meteorological records for the year are given in Appendix II. The total rainfall was 102.35 inches compared with 117.00 inches in 1954 and the average rainfall in the past eleven years of 105.09 inches. Following the very heavy rains in December 1954 of 26.77 inches, January was unusually wet with 23.84 inches. Thereafter, February and March were much drier than usual; in fact the average monthly rainfall for the months February to June was below average. Consequently, the rainfall was much more seasonal than is usual in Singapore, and this resulted in a heavy flowering and fruiting, especially among indigenous plants, both here and in the Federation of Malaya. The highest rainfall in 24 hours was in July, when out of a total of 7.14 inches for the month, 5.20 inches fell in one day.

11. The highest shade temperature recorded during the year was 96°F. in May and the lowest was 71.2°F. in August; the mean maximum temperature being 86.9°F., the mean minimum 74.3°F., while the average temperature at 9.30 a.m. was 80.9°F. The mean relative humidity was 81.7 per cent.

IV. BOTANICAL WORK AND HERBARIUM

(i) COLLECTING

12. With more botanists now on the staff the amount of collecting done during the year was greatly increased. This adds much to the value of our work, as, not only is useful material added to our collections, but it is of great help in connection with our *Revised Flora of Malaya* and the *Flora Malesiana.* Duplicates are also obtained for distribution to, and exchange with other herbaria.

13. Three plants which are new to the Flora of Singapore Island were collected during the year. These were *Dipterocarpus apterus, Cyperus sanguineolentus* subsp. *cyrtostachys* and *Cymodocea rotundata.* The latter found at Teluk Paku is a marine flowering plant and is also a new record for Malaya. Considering the very extensive collecting which has been made in Singapore over the past 130 years and the continued clearing and destruction of vegetation, it is somewhat surprising that new records and sometimes new species can still be obtained on this small island. Two species of plants, which had not been found for many years, were also collected, namely, *Halophila spinulosa* at Tanah Merah Besar and *Cynometra ramiflora* in the Kranji Nature Reserve. Notes of all the above plants, together with other new records and rarities from Singapore, will be published in the next number of the *Gardens' Bulletin.* Another interesting discovery during the year was *Aponogetum loriae* in the Van Kleef Aquarium. Plants had been brought in from Kota Tinggi for growing in the aquarium tanks. This is a new record for Malaya, having only been found previously in New Guinea and S.W. Celebes in the Malaysian region. It reproduces abundantly by bulbils and flowered in the Gardens' laboratory. The Director made a collection of common Singapore weeds, and even in his garden found some species which had rarely been collected before in Malaya.

14. More collecting was possible in the Federation of Malaya than for many years. The principal collections there were as follows:—

Mr. Purseglove	Fraser's Hill	15–26th April	250 numbers.
Mr. Burkill	Pangkor Island	3–13th July	168 numbers.
Mr. Sinclair	Malacca	1st–6th April	53 numbers.
Mr. Sinclair	Trengganu	4–25th September	226 numbers.

15. In addition, Mr. Sinclair made five minor excursions to Johore, namely, two to Kota Tinggi and one each to Sungei Tiram, Sungei Tebrau and Pulau Pisang. From all the excursions a number of very interesting plants was brought back, including new records for the States concerned and a number of new species. Of the plants collected by Mr. Sinclair in Trengganu, 37 per cent were new records for that State and 11 per cent were new species. In this connection it should be remembered that Mr. Sinclair had previously collected in the same area in 1953 and 1954. While at Fraser's Hill, a friend brought the first plant specimen he had ever collected by himself to me. This was found to be a new species of *Fissistigma* and will be described by Mr. Sinclair as *F. thomasii* to commemorate the collector and this unique occasion. It can thus be seen that there is still ample scope for collecting in the Federation, particularly if the *Revised Flora of Malaya* is to be reasonably complete.

16. In Malaya the sides of most main roads, where they pass through forest or scrub, have been cleared of undergrowth to a depth of 1-2 chains as a security measure. In the Sungei Udang Forest Reserve Mr. Sinclair found that this had caused the trees of 60 to 100 feet in height to put out new branches close to the ground, thus facilitating collecting. It was in this forest that the collector had a somewhat close encounter with a bear, necessitating a quick exit, and the roadside fringe was found to be a better and happier hunting ground for botanical specimens. In Trengganu Mr. Sinclair collected between Kuala Trengganu and Besut, along the unhabited stretch of coast at Bukit Kluang and Bukit Bubus and at Sungei Nerus, which was reached by boat. Once more the Gardens are greatly indebted to Mr. Fyfe and 'Che Ibrahim, the State and District Forest Officers, for all their invaluable help during the Trengganu excursion.

17. The Director visited Western Sarawak during the period 12th-30th September and spent some days collecting in the vicinity of Kuching and thereafter at Lundu and Sematan and on Gunong Gading and Gunong Pueh (4,156 ft.). In all 501 numbers were collected with wherever possible five or six duplicates of each, in addition to a fair number of living plants for trial at the Gardens. The Sarawak Government, the Curator of the Kuching Museum, the Conservator of Forests, Mr. J. E. Seal and others provided most helpful assistance throughout this excursion. The very rich flora of Borneo is still very imperfectly known. In certain families as many as fifty per cent of specimens collected cannot be matched in Singapore and many of these will be species new to science. It was a particular interest to find *Rafflesia tuan-mudae*, close to where Beccari discovered it in 1866. Mention should also be made of *Hedyotis moultonii*, found on Gunong Pueh at 4,000 feet. It had only been collected once before and had been named and described by Ridley in 1939. The inflorescences of this plant, up to 2 feet in length and bearing small white flowers, sprawl on the forest floor and root at the tips, producing new plants, much in the manner of strawberry runners. The latter, of course, never bear flowers. It is obvious that a very great deal of collecting still remains to be done in Sarawak for many years to come.

18. Mr. Burkill has begun a collection of the Malayan seaweeds, a group of plants which had received little attention here in the past. He collected 12 species at Pangkor, all of which were new records for Perak and include *Ulva reticulata, Amphiroa fragilissima, Turbinaria conoides* and *Colpomenia sinuosa.*

(ii) EXCHANGE AND LOAN OF HERBARIUM SPECIMENS

19. The routine work of drying, poisoning and mounting specimens went on during the year. Some 2,351 sheets were mounted, but many of these could not be laid in their proper place in the cabinets, since these are now full and new cabinets are urgently wanted. We received 2,451 specimens in exchange from other herbaria or donated by individual collectors. The donors were the herbaria of the British Museum, Kepong Forest Research Institute, Hong Kong, Leiden and the Morris Arboretum; the Forest Departments of Bangkok, Lae, North Borneo and Sarawak; Lord Talbot de Malahide, British Ambassador to Laos, Mr. J. E. Seal of the Department of Civil Aviation, Sarawak, Mr. J. A. le Doux of Kota Tinggi and Mrs. B. E. G. Allen. Our grateful thanks are due to them for these valuable specimens. The Agricultural Department, Kuala Lumpur, kindly donated a number of sheets of Wray's specimens collected in the 1880's.

20. 2,167 duplicate specimens were distributed to the herbaria of Bogor, British Museum, Delhi, Edinburgh, Kepong Forest Research Institute, Kew, Leiden and Paris, compared with 3,321 in 1954. This decrease is due to lack of funds for postage and the fact that many of the collections made in 1955 were not ready for distribution at the end of the year.

21. The number of specimens sent out on loan to botanists working on the *Flora Malesiana* at Bogor, Cambridge, Kew, Leiden and to other specialists increased from 3,097 to 4,903. The families sent on loan were Flacourtiaceae, Malvaceae, Restionaceae and Bambusae, some Dipterocarpaceae and Ericaceae and the genera *Calophyllum, Kayea, Ochrocarpus* and some *Ficus* spp. It adds greatly to the usefulness and value of our herbarium when these specimens are returned correctly annotated.

22. In addition to providing herbarium material on loan or exchange for study by research workers in other countries, many requests were received for living plants, seeds and spirit material for study by specialists elsewhere, and wherever possible the material required was provided. The Gardens co-operated fully with the Botany Department of the University of Malaya and provided material for class work and research.

(iii) TAXONOMIC RESEARCH

23. Mr. Sinclair continued his revision of the Malayan species of Myristicaceae (nutmeg family) and his manuscript was nearly completed by the end of the year. Dr. Furtado completed his long paper on *Calamus*, the rattan genus of palms, and it has now gone to press. In the revision there are 72 species of *Calamus* in Malaya compared with 46 in Ridley's *Flora*, while two of the latter have been transferred to the new genus *Cornera.* In addition to their research, the Keeper of Herbarium and the Assistant Botanist have carried out routine determinations of the in-coming specimens, while the Director and Assistant Director have named their own collections. Certain species collected have been sent to experts in various parts of the world working on individual groups or families for critical determination.

(iv) WEEKLY EXHIBITS OF WILD PLANTS

24. The weekly exhibit of seven wild plants in the plant house begun in November, 1954 was continued throughout the year. It continued to be popular and has stimulated interest in the local flora.

V. HORTICULTURAL WORK

(i) GENERAL

25. Clearing of thickets, cutting of grass and the sweeping of leaves occupied much of the time of the general labour force. The greater part of the clearing was done on lawns W, X and Y, which have been somewhat neglected in the past. A considerable amount of wanton damage was done in the nursery and the pot plants were moved from there to the orchid enclosure. It is still necessary to maintain sufficient stocks of planting material in the nursery beds, both for Gardens' requirements and for sale, and it is desirable that the area should be enclosed with a security fence. With the employment of a new pot-plant gardener and their removal to the orchid enclosure, the standard and range of pot plants has improved. Two large *tembusu* trees (*Fagraea fragrans*) in the Arboretum were uprooted with a Trewella winch, which effected a great saving in labour. The trunks were cut up into suitable lengths and used as posts for the new pergolas in the plant house. Adequate spare-parts were available for the motor mowers, with the result that there were few stoppages and lawns for the most part were kept in good condition. Exceptions were lawns P, Z and Y, where conditions are too rough for existing machines and a strong motor scythe is required for this work. Now that ample quantities of animal manures are available composting is being done on a greatly increased scale. To save transport and labour, compost heaps were made on various lawns throughout the Gardens. They can be kept tidy and it is hoped that they will serve as an object lesson to visitors.

26. Inevitably in a large plant collection such as this, with over 3,000 species growing in the Gardens—and this does not include annuals and hybrids—losses occur from time to time. The more serious losses during the year were *Araucaria braziliensis*, which died on Lawn C and the Seychelles double coconut or *coco de mer* (*Lodoicea seychellarum*), which was killed by red-stripe weevils (*Rhynchophorus schach*) on Lawn K, while the second specimen of this species was killed by falling branches of *Kurrimia paniculata* near the Cluny Road entrance, which blew down in December and which also necessitated the cutting down of this very fine tree. Fortunately four seeds of the double coconut had been obtained from the Seychelles and were planted on Lawn W. The avenue of sugar palms (*Arenga saccharifera*) along the road to the Tyersall Gate had to be taken out in making the new orchid enclosure. These palms usually flower and die after about 25 years, and as flowering had already begun they would have had to have been taken out soon in any case.

27. All the time new plants are brought in for trial and after establishment are planted out in the Gardens. Among these a white variety of *Petraea volubilis* was planted on Lawn H and a fine new *Mussaenda* "Dona aurora" is now well established. *Mucuna rostrata*, the seeds of which had kindly been sent in March 1954 by Dr. Herklots, Principal of the Imperial College of Tropical Agriculture, Trinidad, flowered for the first time at the end of the year. Although the inflorescence is not as big and the flowers not as brilliant as *Mucuna bennettii*, nevertheless, its waxy orange flowers are most attractive. A different species of creeper was planted at each of the *tembusu* posts on the

new pergola in the plant house and were as follows: *Anthurium digitatum, Argyreia nervosa, Beaumontia murtonii, Combretum farinosum, Hieris curtisii, Hosea lobbii, Mandevilla suaveolens, Odontodenia speciosa, Pandorea pandorana, Pergularia odoratissima, Petreovitex wolfei, Philodendron imbe, P. lacerum, P. laciniatum, P. oxycardium, P. sagittifolium, P. squamiferum, Rhapidophora korthalsii, R. maingayi, Scindapsis aureus, Solandra grandiflora, Solanum seaforthianum, S. wenlandii, Strongylodon macrobotrys, Syngonium auratum* and *S. podophyllum.*

28. A fine-leafed variety of *Zoysia* has made an excellent lawn at the plant house and it is a great improvement on any other grass used for lawn making in Singapore. The beds along the Main Gate Road, which had grown Cannas for very many years were dug up and rested from February to November. They were then heavily manured and each bed replanted with a different Canna variety. New Canna beds were also made on Lawn O surrounding the bandstand and provide welcome colour at this central and conspicuous point in the Gardens. The Lotus (*Nelumbium speciosa*) spread with alarming rapidity over the greater portion of the lake and threatened to suppress the waterlilies. They were controlled temporarily by cutting, as it was impossible to lower the lake level for more than a few days to root them out and weeding had to be restricted to that which could be done from the boat. *Bougainvillea glabra* var. *magnifica* has long been difficult to root, but it was found that young soft shoots, about 3 inches long, root fairly easily in burnt earth in full exposure. *Grammatophyllum speciosum,* the largest indigenous Malayan orchid, flowered profusely throughout the Gardens from October to December. In the Gardens' Jungle, a tree of *Homalium grandiflorum* var. *grandiflorum* flowered profusely at the end of July. According to Ridley, the tree flowers rarely, probably once in twenty-five years.

29. A trial of maleic hydrazide, a growth inhibitor, was carried out on grass plots containing *Axonopus compressus, Chrysopogon aciculatus, Ischaemum timorense* and some sedges. Applications were made at the rate of 5, 10 and 12 pounds per acre, together with control of untreated plots. In the treated plots the flowering of the *Chrysopogon* was much reduced, but the growth of leaf of all grasses was not noticeably inhibited.

30. The wild longtailed macaque monkeys (*Macaca irus*) increased considerably during the year. While providing a very great attraction to visitors, they are an unmitigated nuisance as far as horticulture is concerned and do a great deal of damage to plants and fruits. A few vicious males were shot during the year, but their numbers should be reduced.

(ii) ORCHIDS

31. At the beginning of the year most of the Gardens' collection of cultivated orchid species and hybrids was transferred from the Director's garden to the new orchid enclosure on lawns P and R. Separate structures were erected for the orchids growing in the hanging pots, as the Dendrobiums require full sun and the strap-leaved Vandas prefer half shade. Beds were dug for planting terete and semi-terete Vandas, Arachnis, Renantheras and their hybrids. Many tons of compost were required and this was made by utilising all refuse and grass cuttings, together with cattle manure from the Animal Quarantine Station and horse manure from the Singapore Turf Club. Most of the orchids have benefitted from the move, the more robust and healthy growth of the Dendrobiums being particularly noticeable. The new site is obviously better than the old one. There is also room for expansion and less likelihood of theft or damage.

32. During the year 215 pollinations were made, of which 70 of the crosses have produced good viable seeds and are now growing in flasks. Seeds from the cross *Euanthe sanderiana* x Vanda Tan Chay Yan are growing well and the results may well be spectacular. Three very good hybrids—Vandanthe Nellie Morley, Vanda Jean Kinlock Smith and Dendrobium Pompodour var. Phra Taba have so far not produced any fertile seeds when crossed with other species and hybrids. Good plants were received of Vandanthe Nellie Morley, Hawaii's best semi-terete hybrid, and *Euanthe sanderiana* in exchange for plants of Vanda Tan Chay Yan, while reciprocal exchange was arranged with Messrs. William Kirch of Hawaii, from whom were received some of the latest Hawaiian hybrids. A number of new hybrids flowered for the first time, of which the best were: Dendrobium Gillian, (D. Caesar x D. Champagne), which is more robust than Dendrobium Caesar, although resembling it in colour: Aeridanchnis Sweet Maggie (Arachnis Maggie Oei x *Aerides odoratum*) with small attractive flowers which are very freely produced; Dendrobium Lim Chong Min (*D. phalaenopsis* var. *schroederianum x* D. Caesar) which is far superior to an earlier cross made with *D. phalaenopsis* var. *alba;* and *Dendrobium undulatum* selfed, of which an orange-brown variety stayed in bloom for over two months. Descriptions of the new orchid hybrids were published in the *M.A.H.A. Magazine* of the Malayan Agri-Horticultural Society.

33. Vanda Tan Chay Yan continues to be very popular, both locally and overseas, and the demand for plants exceeds supplies. Shoots (anaks) are not easily produced from the base of cut plants, but this was accelerated by using the paste of Hortomone A with water, which was copiously applied to the axils of the leaves and nodes.

34. When there is unavoidable delay in potting up seedlings from the flask stage these tend to shrivel. This was remedied by feeding with organic fertilizers, usually fish emulsion. The use of Vacin's formula for the flasks was continued, but the incorporation of fish emulsion during growth is found to be beneficial. In the seedling houses the seedlings received weekly dressings of solutions of inorganic fertilizers. Trouble was still experienced with the drainage holes of the thumb pots being blocked by algae, but this was overcome by putting the pots in a layer of coke about two inches deep, and the plants made excellent growth. Sterameal was used for feeding the larger seedlings.

35. Selected orchid flowers have been sent from time to time to the fortnightly shows of the Royal Horticultural Society in London and also the Chelsea Show. On several occasions the blooms arrived in poor condition, although Dendrobium Caesar was given special mention. Bouquets of orchids were also sent on occasions to Malaya House in London and were displayed in their window facing Trafalgar Square. Orchids from the Gardens were also exhibited at flower shows in Karachi and Sydney. One of the new hybrids, Arandanthe Tyersall var. Bulan, was awarded a cup for the best hybrid produced in Malaya and Java at the Singapore Flower Show.

(iii) SUCCULENTS

36. A new succulent house was built in the orchid enclosure and most of the collection was moved down from Lawn X. The number of species grown was added to during the year by seeds sent in exchange by Botanic Gardens elsewhere and we now have some 400 species. Most cacti and other succulents grow surprisingly well in Singapore, provided they are sheltered from the rain, and the new open-sided house with a glass roof suits them admirably.

Exceptions are the stone plants, belonging to the genera *Argyroderma*, *Conophytum* and *Pleiospilos*, and these will not be tried further. The popularity of succulents among local growers continues to increase and we could not meet all the requests for the purchase of plants. In fact it was found necessary to stop all sales in the middle of the year in order to conserve our collection. With the new house, however, increased sales can be expected in 1956.

(iv) PLANT SALES AND EXCHANGE

37. Plant sales during the year totalled 2,730 orchids (plants, cuttings and seedlings), 874 succulents and 24,224 miscellaneous plants. The revenue obtained was $22,187, compared with $19,416 in 1954. This increase was due to orchid sales which produced $16,005, an increase of $4,085 over the previous year. We provided 6,979 plants free of charge to Government institutions and schools.

38. 514 packets of seeds and 113 plants were despatched on an exchange basis and 362 packets of seeds and 371 plants, including gifts, were received in return. A list of the institutions and persons with whom planting material has been exchanged and who have donated plants and seeds is given in Appendix III. Members of the staff brought back living material of 83 species from their various expeditions, many of which are new to the Gardens.

39. During the year 3,300 potted plants were loaned for Government and charity functions, while plants were also provided for the Chief Minister's Office.

VI. ADVISORY WORK

40. The Rural branch of the Public Works Department was in constant contact with the Department and the planning of layouts for roadsides or open spaces was carried out. In Nicoll Drive alone 370 trees were provided free of charge by the Gardens Departmnt. They consisted of 75 *Terminalia*, 70 Royal palms, 46 *Peltophorum*, 138 Tamarinds, 4 *Delonix* and 40 *Arfeuillia*, while many more are still to be planted. 200 to 300 shrubs were planted along the Bukit Timah Road near the turnabouts, thus continuing the work begun last year, and still more remains to be done.

41. Contact was maintained as usual with the City Council Parks Department and information and plants were exchanged. Advice was given, and in a number of cases plans were submitted to institutions, such as the School for the Blind, the Civil Defence, the Auxillary Fire Service and many other public bodies.

42. The large *Ficus religiosa*, which was transplanted in the Paya Lebar International Airport in 1954, did not survive, but marcots from the original tree are growing satisfactorily.

VIII. THE RIDLEY CENTENARY

43. On the 10th December, 1955, Mr. Henry Nicholas Ridley, C.M.G., M.A., F.R.S., F.L.S., the first scientific director (1888-1912), celebrated his hundredth birthday anniversary at his home at Kew in England. The Gardens marked the occasion by a Ridley Centenary Exhibition held from the 10th-15th December in the herbarium, library, laboratory and offices. In this was demonstrated some of Mr. Ridley's major contributions to the knowledge of the natural history of Malaysia and his pioneer work on rubber, which led to the

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Mr. David Marshall, Chief Minister of Singapore, congratulating Mr. H. N. Ridley, C.M.G., F.R.S., Director of the Singapore Botanic Gardens 1888–1912, on his hundredth birthday and presenting him with a Kelantan silver tea service at Mr. Ridley's home at Kew

Public Relations

His Excellency the Governor of Singapore, Sir Robert Black, signing the visitors book at the Ridley Centenary Exhibition, 10th December, 1955

Public Relations

Tuan Haji Mohamed Nur bin Mohamed Ghous, B.E.M., Herbarium Assistant and Che Ahmad bin Hassan, Seed Collector, who have completed 43 years and 54 years service respectively at the Singapore Botanic Gardens

Public Relations

Director's Office and Laboratory, Singapore Botanic Gardens, with herbarium behind

Public Relations

Mounting herbarium specimens, Singapore Botanic Gardens

G. H. Addison

Beaumontia murtonii Craib, a handsome woody climber. It was named in honour of W. J. Murton, Superintendent of the Botanic Gardens, Singapore 1875–1880, who first collected it

G. H. Addison

Avenue of Royal Palm—*Roystonia (Oreodoxa) regia*, 5 years old, on the Office Gate Road, Singapore Botanic Gardens

founding of Malaya's principal industry. Past and present work of the Department was also shown. H. E. the Governor and Lady Black, the Commissioner-General and Lady Scott, and some 600 invited guests visited the exhibition, which was thrown open to the public on 15th December. The Government Printer very kindly printed a brochure to commemorate the occasion, a copy of which was given to the guests and also distributed overseas. A copy bound in green morocco leather was presented to Mr. Ridley.

44. On the evening of the 10th December over 100 guests attended a cocktail party in the Director's house, where Mr. Ridley had lived for twenty three years. Proposing Mr. Ridley's health, H. E. the Governor, Sir Robert Black, said that Mr. Ridley, "was in the best tradition of those who over the years have come from overseas to serve Malaya, whatever criticisms may now be levelled at their heads, in that he placed obligation above privilege, and found his best reward in the prosperity and increasing well-being of the people of the country . . . I am sure that everyone will join with me in congratulating Mr. Ridley, who has made such an outstanding contribution to the wealth and knowledge of Malaya and Singapore, on this very happy occasion of his centenary."

45. The portion of the Gardens along the Office Ring Road, the Lower Ring Road and adjacent areas, as well as the office and herbarium buildings and plant house, were floodlit for eight nights during 10th-17th December and attracted large crowds. Floodlighting of some of our very fine trees, such as *Hymenaea courbaril*, *Koompassia malaccensis* and *Terminalia subspathulata*, provided some very beautiful effects which will long be remembered. Mr. Siddaway, Electrical Engineer of the Public Works Department, and his staff are thanked for installing the apparatus. Four concerts beginning at 9 p.m. were given during the week by the following bands: The Band of the 1st Battalion of the Queen's Royal Regiment, in conjunction with choral items given by the Singapore Chamber Ensemble, The Singapore Police Force Band; the R.A.F. Band of the Far East Forces and the Royal Marine Band of the Commander-in-Chief of the Far East Station. To them our thanks are due.

46. Radio Malaya produced an hour's feature programme entitled, "They Called Him Mad" for the occasion, which included the recorded voices of Mr. Ridley himself, Sir Richard Winstedt, R. J. Farrer, Ahmat bin Hassan, R. E. Holttum, Young Chao Sian (118 year-old Chinese calligraphist), Dr. Howes, Tan Hoon Siang, Gerald Hawkins and J. W. Purseglove. The Director also made other broadcasts for Radio Malaya and the B.B.C. Mr. David Marshall, Singapore's Chief Minister, presented Mr. Ridley personally with a silver Kelantan tea set on the birthday, while the Gardens sent a bouquet of Singapore orchid hybrids. The Rubber Growers' Association gave him a bronze bust of himself, while a further bust will be placed in their London headquarters.

47. Among the many congratulatory telegrams received by Mr. Ridley was one from Her Majesty the Queen. Sir Richard Winstedt described him recently as "the one man whose influence on Malayan history is second only to that of Raffles". The staff at the Gardens have every reason to be proud of Mr. Ridley, not only for his great achievements and all that he did for us and Malaya so long ago, but also for his remarkable longevity. It was good to hear from Mr. Ridley that "my hundredth birthday was one of the most enjoyable days of my life".

VIII. LABOUR

48. The average daily-rated staff at the Gardens was 78. A total of 221 man-days was lost on account of sick leave, as well as a great deal of time lost by people spending three to four hours attending the hospital for minor treatment, not covered by sick certificates. Wages amounted to $110,639 during the year. At Government House the average labour force throughout the year was 57. Their health remained good. No labour trouble occurred at either place.

IX. BUILDINGS AND ROADS

49. Re-decorating of the offices and herbarium was completed early in the year, as was the building to house the spirit collection, which is now used temporarily as a library. This building is connected with the herbarium by a covered passage and later a small fumigation chamber was added to the end of it. This has been required for many years, as it is essential that herbarium specimens sent to us from other countries for study, or for incorporation in our collection, should be thoroughly fumigated, as should new gatherings by the staff, in order to prevent insect infestation which could so easily and so quickly do untold damage. Similarly it will be very useful for checking outbreaks of insect pests which damage our books and papers and for fumigating introductions of live plants. The chamber was so designed that methyl bromide and other fumigants can be used. The main buildings at the Gardens in their new colours fit in very well together and with their surroundings. They form an attractive group. The plant house, tea-kiosk and bandstand were also re-decorated during the year.

50. Work continued on the pergolas at the plant house. Two old pipe and angle-iron archways were removed, as were mounds and benches. The new flat-topped pergolas of *tembusu* poles are a very great improvement. The east side of the plant house still remains to be re-constructed. The old iron archway on Lawn O was demolished and replaced by a flat-topped brick and *tembusu* structure. Unfortunately the money voted as special expenditure to re-roof the almost-derelict fern and orchid house was withdrawn on the grounds of economy.

51. The part of the Gardens which has developed most during the year is the new orchid enclosure, made at the end of 1954 by enclosing Lawns P and R with a wire mesh security fence with a double barbed-wire apron. The fence itself was made "monkey-proof" by electrifying two of the top wires. This has proved very effective and the cost of doing so will be saved in one year from the over-time which was paid employing a labourer throughout the daylight hours to keep the monkeys out of the enclosure. Within the enclosure structures were erected for the hanging orchids, benches were transferred and constructed for the orchids in pots and other pot-plants, two potting sheds (one for orchids and the other for miscellaneous plants), a cactus house and a shed for burning earth were built. Cement water tanks were constructed and the central tank in the Gardens' Jungle was connected to the city water supply, which can now be used in an emergency, should the present supply pumped from the lake fail at any time. The centralising of the main work on orchids, pot-plants and new introductions within the orchid enclosure has obvious administrative advantages and permits closer supervision.

52. No work on roads, paths and drains was done by the Public Works Department during the year, but the Gardens' staff repaired the brick drains

where necessary. Sodium chlorate was used to keep down weeds on those paths which do not drain into the lake, but cannot be used on those which do, as it might kill plants and fish. The path on the east side of the plant house, which was dangerous when wet, was dug up, levelled and relaid. Baskets for litter were put up at strategic points within the Gardens; previously none has been provided. It now remains to be seen whether the public will use them.

X. LIBRARY

53. Dr. (Mrs.) A. Johnson, was engaged as a part-time librarian for 7½ months and catalogued the library. The last published catalogue was done in 1898. The books were classified on the Universal Decimal System and were found to number some 8,000 bound volumes. There is in addition the very large number of volumes waiting to be bound. Our oldest book was found to be Paulus Aeginetes' *Pharmaca Simplica* and *De Retione Victus*, which was published at Strasburg in 1531. Our collection includes many eighteenth and early nineteenth century publications, many of them with handsome coloured plates, which are very valuable and many of them now unobtainable. Seventy books were added to the library during the year.

54. The new room, built to house the spirit collection of plants, was air-conditioned and fitted with new book cases. It is being used temporarily to house the more valuable books and those in more general use, until such time as a new library is built. According to the development plan this is scheduled in 1957. The present building will only hold part of the library and there is no room for expansion. A man was fully employed for the whole year hand-poisoning all the library books and this, together with the removal to the air-conditioned room, has halted the delapidations recorded in last year's report.

55. It is estimated that there are about 1,000 volumes waiting to be bound, both periodicals and old volumes in need of rebinding. The back-lag is a matter of some concern. The Government Printer bound a few volumes during the year, but it is obvious that he cannot cope with the great amount to be done, and failure to bind them will result in further deterioration. In addition it makes reference work very difficult and tedious and much time is wasted searching through piles of unbound periodicals.

56. Exchange arrangements with scientific institutions for the *Annual Report* and *Gardens' Bulletin* were reviewed during the year. A circular was sent out with last year's *Annual Report*, asking institutions if they wished to receive one or both publications and what they could offer in exchange. Reciprocal exchange was reconfirmed or was proposed and accepted with 117 overseas institutions, while negotiations with a few others are still in progress. In this way it has been possible to augment the number of useful periodicals received by the library.There is insufficint money in the library vote to pay for binding or to purchase all the books which should be added to the library.

XI. BAND CONCERTS

57. Concerts by the military bands on duty in Singapore were begun on the 20th February and were continued during the year on alternate Sundays at 5 p.m., thanks to the courtesy of the General Officer Commanding the Singapore Base District, Major-General D. D. C. Tulloch, C.B., D.S.O., M.C. The concerts have proved extremely popular and very large crowds have come to

listen to them, sometimes as many as 2,000 people. Since the founding of the Gardens on their present site in 1859, concerts in the bandstand have been a regular feature, although there had been periods when no band has performed. The last concert had been given early in 1953 and it is pleasing to report that their resuscitation has proved such a great attraction.

58. The bands of the following regiments performed during the year: 15/19th The King's Royal Hussars, 11th Hussars, 1st Battalion, The Royal Scots Fusiliers, 1st Battalion, The Royal Hampshire Regiment, 2nd Battalion, Royal Welch Fusiliers, 1st Battalion East Yorkshire Regiment, 1st Battalion, Northern Rhodesia Regiment, 1st Battalion, The Queen's Royal Regiment, 1st Battalion, The King's Own Scottish Borderers and the 1/10 Gurkha Rifles. The King's Own Scottish Borderers, in addition to providing band items, also performed a set of pipe tunes and sword dance by four pipers in full dress, while the Northern Rhodesia Regiment gave an impressive display of marching on the Upper Ring Road. The Commanding Officers of the above regiments and the bands are thanked for providing many excellent and colourful concerts.

XII. GARDENS' BY-LAWS

59. As reported last year no new by-laws have been made since 1922, and the governing principal legislation, the Raffles Society Ordinance of 1878, is under revision.

XIII. GARDENS' TRAINEES

60. During the year fifteen trainees were accepted from the Singapore Anti-Tuberculosis Association and the Rehabilitation Centre of the Labour Department. They spend six months at the Gardens and receive instruction in the various sections to which they are attached.

XIV. GOVERNMENT HOUSE DOMAIN

61. The grounds were kept in their usual good condition. The most notable improvement during the year was the removal of the old rockery round the pool on the top lawn and the concrete divisions in the pond itself. The area round the pool was then levelled and turfed. This work improved the vista from the front of Government House. At a small cost it had provided a simple dignity which was previously lacking. The pergolas now play a very essential part in the design, and the *Mucuna bennettii* on them flowered well, more especially towards the end of the year, when the weather was cooler and wetter. The design of the 'new garden' was also improved by the removal of the standard *Hibiscus*, which broke up the lawn, and by replacing the long mixed herbaceous borders along the top of the bank with two small beds of *Mussaenda erythrophylla*. The triangular section near H. E.'s Office was re-modelled and part of it was turned into a car park. A new hedge of *Baphia nitida* planted near the second gate is forming a good screen.

62. With the purchase of a Dennis motor mower with two wide-cuts, it was possible to give more attention to, and to improve the large grass areas in the outlying portions of the Domain. During the long dry spell in March many lawns suffered and turned brown, an unsual occurrence in Singapore. Adequate supplies of spent hops, horse manure and cattle manure were obtained for the Domain and large quantities of compost were made. The plant house in the potting yard was repaired by the Public Works Department and the foliage plants improved considerably when transferred to it from under the trees where

they had been growing for some months. The supply of cut flowers was increased and pot plants and vegetables were provided as usual. Work was also done at the Changi Cottage.

63. Some repairs and improvements were made to the grounds of the Speaker of the Legislative Assembly's residence at 172 Mount Pleasant Road, for which a small additional vote was provided.

XV. KRANJI WAR CEMETERY

64. The Director of Botanic Gardens, with the approval of the Singapore Government, became the Imperial War Graves Commission's representative in Singapore to take charge of the care and maintenance of their Kranji War Cemetery. The Gardens took over the administration and work at the cemetery from the 1st June, 1955, funds for the upkeep being provided by the Imperial War Graves Commission. Work continued on the regrading of the cemetery and the replanting of the lawns with *Axonopus compressus*. This was nearly completed by the end of the year. The replanted area was top-dressed with sludge purchased from the City Council, and resulted in a strong growth of rich, green grass. Trial plots of lawn grasses of *Zoysia* sp. and *Cynodon dactylon* were laid down. A large number of shrubs and herbaceous perennials was planted in headstone borders according to the Commission's plans.

XVI. NATURE RESERVES

65. The Board of Trustees of the Nature Reserves met on three occasions to conduct business, namely, 31st January, 2nd May and 17th November. A meeting arranged for the 29th July had to be cancelled as no quorum could assemble. Mr. John Laycock and Mr. C. C. Tan resigned from the Board of Trustees on the 4th April and 15th July respectively. Their places, available to the Legislative Assembly, remain vacant. Mr. A. Thompson of the Department of Botany of the University of Malaya retired from the Board on 28th June on the expiry of his term of office and his place has been taken by Dr. H. B. Gilliland, the new Professor of Botany, from the 24th September. Mr. R. S. Boswell acted for Mr. A. L. B. Swaine as representative of the Rural Board during the latter's absence on leave. Mr. Yap Pheng Geck, representing the City Council, and Mr. M. W. F. Tweedie, a Governor's nominee, served throughout the year. The Director of Botanic Gardens was *ex-officio* Chairman.

66. Supervisory staff was appointed in the employ of the Board with effect from 1956. Seven labourers at Bukit Timah and two at Kranji were employed during 1955, and in these reserves no major acts of vandalism or timber cutting occurred. At Pandan some cutting continued and encroachment by prawn ponds occurred at two points in the Pengkang sector. A corner of the Kranji Reserves was cut for road widening and realigning operations by the Public Works Department. Unfortunately this destroyed three of the four known specimens of *Cynometra ramiflora* on Singapore Island.

67. The Police continue to use the summit on Bukit Timah as a radio station. The approach road to the summit through the Hindhede Quarry was closed due to quarrying downwards and an alternative trace was made by the Company from the Reserves' labour quarters. Owing to the excessive gradient, this was found to be expensive to maintain and unsafe, particularly in wet weather, for any transport except four-wheel drive vehicles. Consequently, the old road through the quarry will be maintained, culverts being constructed wherever quarrying cuts into its course. It is hoped that the threat of quarrying

which has hung over Bukit Timah for many years, and which has so disfigured the hill, will be diminished now that the Hindhede Quarry will only be allowed to work downwards and at least two of the other quarries will be closed. The Bukit Timah bungalow and its land (Lot 67-31) has now reverted to the Crown and formal application has been made for it to be included in the reserve. The bungalow would provide a useful resthouse for scientists and others.

XVII. SINGAPORE GARDENING SOCIETY

68. The membership of the Society increased to 245 by the end of the year. Seven of the monthly meetings were held at the Botanic Gardens. A very successful flower show was held at the Happy World Stadium on the 1st-3rd April. Although the number of entries was slightly fewer that the previous year, the quality of the plants was higher and competition was keener, more especially in the orchid section. Mr. J. W. Ewart was President for the Society for the year 1954-1955 and was also Chairman of the Flower Show Committee. Mr. G. H. Addison and Mr. J. L. Pestana were Honorary Show Manager and Assistant Show Manager respectively and several members of the Gardens' staff acted as judges.

XVIII. VISITORS

69. A large number of visitors, both official and casual, came to the Gardens during the year and were shown round by the Director or members of the staff. Visitors from overseas included: Professor H. G. Champion, Director of Imperial Forestry Institute, Oxford University, Mr. F. S. Collier, Forestry Adviser to the Secretary of State for the Colonies, Dr. L. T. Ride, Vice-Chancellor of the University of Hong Kong, Miss Dinah Sheridan, film-star, Mr. John Davis, Managing Director of J. Arthur Rank Organisation, Mr. G. W. Nye, Deputy Agricultural Advisor to the Secretary of State for the Colonies, Lord Talbot de Malahide, British Ambassador to Laos, Professor R. Cerighelli, Marseilles University, Dr. Marta Woermann, Heidelberg, Dr. Jose Trujillo, Ecuador Ambassador to the United States of America, Dr. Viquia, El Salvador Ambassador to the United States of America, Dr. P. Wiehe, Director of the Sugar Research Institute, Mauritius, Mr. D. B. Paguirigan, Director of The Bureau of Agricultural Extension, Philippines, Mr. Con O'Neill, British Charge d'Affaires at Peking, Dr. Wm. Beebe of the New York Zoological Society, Mr. G. Clutton, British Ambassador to the Philippines, Professor W. E. Meserve, Cornell University, Lady Patricia Lennox-Boyd, Mons. Saphon, Directeur de Service Veterinaire, Cambodia, Mons. Sayang, Directeur de l'Ecole Nationale d'Agriculture, d'Elevage et de Sylviculture, Cambodia, Dr. R. Aitken, Vice-Chancellor of Birmingham University, Professor Jitsuro Ueno, Osaka City University, Sir Edward Boyle, Financial Secretary to the United Kingdom Treasury, Professor C. F. Schmidt, University of Pennsylvania, Mr. K. Suvatabandhu, Chief of the Botanical Section, Agricultural Department, Bangkok, Dr. C. F. Hickling, Fisheries Adviser to the Secretary of State for the Colonies, Mr. J. E. Mayne, Colonial Office, Mr. Stuart Hood, Head of the B.B.C.'s Overseas Service, Professor H. W. Anderson, University of Illinois and Mr. Young Chul Chang, Head of Agricultural Technical Institute, Korea.

70. Visiting botanists worked for varying periods in the herbarium during the year. They, together with the group of plants studied, included: Mrs. B. E. G. Allen (ferns), Dr. G. A. Prowse (fresh-water algae), Professor K. N. Kaul, Director of the Lucknow Botanic Gardens (palms), Mr. J. Wyatt-Smith

of the Kepong Forest Research Institute (Calophyllum), Professor H. B. Gilliland, University of Malaya (Singapore plants), Dr. P. B. Tomlinson of Leeds University (palms), Mr. M. Jacobs of Leiden (Malpighaeceae), Dr. J. Fogg, Director of the Morris Arboretum, United States of America (Rauwolfia) and Mr. N. W. Simmonds, Senior Cytogeneticist of Banana Research Scheme, Trinidad (bananas).

71. Dr. Prowse, Botanist/Algologist of the Malacca Fish Culture, Research and Training Institute arrived in Singapore on 7th November, and is working temporarily in our laboratory until accommodation is available for him at Malacca. He has made many interesting discoveries among the fresh-water algae in the Gardens' lake and elsewhere in Singapore and Malacca. Dr. Tomlinson of Leeds University, who is working on the anatomy of palms at the University of Malaya with an Agricultural Research Council scholarship, spent some time in the herbarium and Gardens, working in conjunction with Dr. Furtado, Assistant Botanist, a world expert on the taxonomy of palms.

XIX. PUBLICATIONS

72. The second volume of the *Revised Flora of Malaya* on the *Ferns of Malaya* by Professor R. E. Holttum, was printed by the Government Printer in 1954 and issued early in the year. It embodies the results of some 30 years' research on this interesting group by Dr. Holttum, together with new ideas on their classification, and includes an Appendix on the *Cytology of one hundred Malayan ferns* by Professor I. Manton. The volume contains 643 pages and some 650 species of Malayan ferns are described, while keys are provided for their identification.

73. A lengthy number of the *Gardens' Bulletin, Vol. XIV No. 2* was published in February. This includes a long paper by Mr. Sinclair on the revised taxonomy of the Malayan Annonaceae. The book on *Malayan Orchid Hybrids* by G. H. Addison and M. R. Henderson, in which all the orchid hybrids grown in Singapore are illustrated, went to press and publication is expected in mid-1956. Booklet III of *Malayan Garden Plants—Ten Orchids* was reprinted by the Government Printer. The revenue from the sale of publications at the Gardens was $864.

74. The following articles were published by members of the staff during the year:—

ADDISON, G. H.—Cactus and succulents in Malaya. *M.A.H.A. Mag., XII,* No. 1, 13–15, No. 2, 21–23; No. 3, 22–23.

ADDISON, G. H.—New Orchid Hybrids raised and flowered in Singapore. *M.A.H.A. Mag., XII,* No. 2, 14–16; No. 3, 14–15.

EWART, J. W.—Saintpaulias, *M.A.H.A. Mag., XII,* No. 1, 16–17.

EWART, J. W.—Potted flowering plants. *M.A.H.A. Mag., XII,* No. 3, 24–27.

FURTADO, C. X.—*Palmae Malesicae*—XVIII. Two new Calamoid genera of Malaysia. *Gardens' Bull., XIV,* 517–529.

GERRARD, ANNE (Dr. A. Johnson)—The germination and longevity of seeds in an equatorial climate. *Gardens' Bull., XIV,* 534–545.

PURSEGLOVE, J. W.—*The Ridley Centenary.* Government Printer, Singapore, 1955.

PURSEGLOVE, J. W.—Mr. Ridley's hundredth birthday. *Nature, 176,* 1092–1093.

PURSEGLOVE, J. W.—Plants for the amateur—I. *Crotalaria retusa, M.A.H.A.* Mag., XII, No. 4, 7–11.

PURSEGLOVE, J. W.—Ridley, Malaya's greatest naturalist. *Malayan Nature J., X,* 43–55.

PURSEGLOVE, J. W.—Botany's contribution to a country's economy. *Sarawak Tribune,* 22-9-55.

SINCLAIR, J.—A revision of the Malayan Annonaceae. *Gardens' Bull., XIV,* 149–516.

APPENDIX I

STAFF OF BOTANIC GARDENS, 1955

DIVISION I–III

Appointment	*Name*	*Remarks*
Director	J. W. Purseglove, B.SC., A.I.C.T.A., F.L.S.	
Assistant Director ...	H. M. Burkill, M.A., F.L.S.	
Keeper of Herbarium ...	J. Sinclair, B.SC.	
Assistant Botanist ...	C. X. Furtado, D.SC.	
Curators (2) ...	J. W. Ewart	On leave 4-12-54 to 18-1-55
	G. H. Addison	
Laboratory Assistant (Special Grade) ...	J. L. Pestana	
Horticultural Assistant ...	A. G. Alphonso	On training Course in U.K. (Kew).
Herbarium and Museum Assistant ...	Haji Mohd. Nur bin Mohd. Ghous, B.E.M.	
Laboratory Assistant ...	Bajuri bin Sappan	
Artist	Juraimi bin Samsuri	
Clerks	Loh Fon Sen	Until 31-5-55
	F. A. Pereira	From 1-6-55
	Vincent D' Rozario	From 3-1-55
	Miss Celine Schelkis	
Despatch Clerk ...	R. Raphael	
Stenographer ...	Miss Diana Foo	
Library Assistant ...	Dr. (Mrs.) A. Johnson ...	From 1-2-55 to 15-9-55
Junior Horticultural Assistant	Abdul Aziz bin Pakiri	
Junior Horticultural Assistant (Govt. House Domain)	Wong Siew Hang	
Storekeeper ...	Ismail bin Ahmad	

METEOROLOGICAL RECORDS

BOTANIC GARDENS, SINGAPORE 1955

Readings Daily at 2.00 hrs. G.M.T.=9.30 a.m. Local Time

Month	Temperatures					Mean Rel. Humidity	Rainfall			
	Mean Temp. at 9.30 a.m.	Highest Max. Temp.	Lowest Min. Temp.	Mean Max. Temp.	Mean Min. Temp.		Rainfall	Average 1945–55 11 Years	Highest Rainfall in 24 hrs.	Number of days
	°F	°F	°F	°F	°F	per cent	in.	in.	in.	
January	78.3	87.5	71.5	83.7	73.4	85.8	23.83	11.39	3.30	22
February	80.4	89.5	71.8	87.1	73.9	79.3	3.16	9.04	1.72	10
March	80.9	90.0	71.5	88.2	74.4	77.9	3.27	9.56	1.25	10
April	81.9	91.5	73.0	88.7	75.1	81.5	8.46	10.09	1.75	21
May	83.6	96.0	72.0	90.7	75.7	80.0	5.02	7.40	1.20	13
June	81.8	92.5	72.5	88.4	75.8	83.8	4.47	6.52	0.85	16
July	80.4	91.0	72.0	86.6	72.0	84.2	7.14	6.96	5.20	15
August	79.3	89.5	71.2	85.3	74.8	85.0	10.09	7.20	3.20	19
September	78.9	90.5	72.0	86.3	74.7	81.4	7.82	7.60	3.20	15
October	81.4	90.5	72.0	86.6	74.0	83.0	7.79	7.29	1.30	24
November	81.4	90.0	72.5	86.3	74.5	81.0	7.17	10.06	2.40	20
December	82.8	88.5	71.5	85.0	72.9	78.1	14.13	11.98	3.64	22
Total or Mean ..	80.9	96.0	71.2	86.9	74.3	81.7	102.35	105.09	5.20	207

APPENDIX III

PLANTS AND SEEDS RECEIVED DURING 1955 FROM THE FOLLOWING INSTITUTIONS AND PERSONS, AND ARE GRATEFULLY ACKNOWLEDGED

Algeria	Jardin d'Eassai, Hamma.
Argentina	Mr. Victor Hanchildt, Puerto Naranjito Missiones.
Australia	Mr. York Meredith, Sydney; Mr. Edward Pulloch, Parkes, N.S.W.
Bahamas	Mrs. Authur Langlois, Nassau.
Belgium	Botanic Gardens, Antwerp.
British North Borneo ...	Mr. Veitch, Sandakan.
Canada	Botanic Gardens, Montreal.
East Africa ...	Mr. C. S. Brisbane.
France	Botanic Gardens of Nantes and Rond-Point de Chamars.
Germany	Botanic Gardens of Bonn, Darmstadt, Frankfurt-am-Main, Hamburg and Mainz University.
Hawaii	Mr. Wm. Kirch, Honolulu.
Holland	Botanic Gardens of Amsterdam and Utrecht.
India	Forest Research Institute, Dehra Dun, National Botanic Gardens, Lucknow.
Indo-China ...	Her Britannic Majesty's Ambassador to Laos.
Italy	Instituto Technico "Zanon", Udine.
Japan	Dr. Ueno, Kyoto University; Mr. Y. Miyasaki, Izu Bunjo; Kyoto Takeda Herbal Garden; Izu Pharmaceutical Garden; Osaka University.
Malaya	Mr. E. F. Allen, Kuala Lumpur; Mrs. F. G. H. Allen, Singapore; Mr. R. C. Barnard, Kepong, Mr. E. F. Brady, Singapore; Mrs. J. C. Cooke, Singapore; Mr. D. C. Doo, Singapore; Dr. Drenth, Singapore; Mrs. M. Ewart, Singapore; Mr. Emile Galistan, Singapore; Mrs. E. J. Henton, Singapore; Mr. J. A. le Doux, Kota Tinggi; Dr. K. L. Mah, Singapore; Singapore Gardening Society; Mr. Tan Chye Siam, Singapore; University of Malaya; Mrs. Wratten, Singapore; Dr. Wycherley, Kuala Lumpur; Mrs. Young, Singapore.
Malta	Argotti Botanic Gardens.
New Guinea ...	Department of Forests.
New Zealand ...	Auckland Museum.
Nigeria	University College, Ibadan.
Poland	Panstwowy Instytut Naukowy.
Portugal	Coimbra University; Museo Abicola do Ultramar.
Sarawak	Forest Department.
South Africa ...	National Botanic Gardens; Kirstenbosch.
Spain	Botanic Gardens, Barcelona.
Sweden	Botanic Gardens of Gottingen and Uppsala University.
Switzerland ...	University of Basel.
Trinidad	Imperial College of Tropical Agriculture.
United Kingdom ...	Royal Botanic Gardens, Edinburgh.
U.S. of America ...	Dr. A. Bernhardt, Brooklyn; Mr. E. A. Menninger, Florida; U.S. Department of Agriculture.

COLONY OF SINGAPORE

ANNUAL REPORT OF THE BOTANIC GARDENS DEPARTMENT FOR 1956

BY

J. W. PURSEGLOVE
Director, Botanic Gardens
Singapore

PRINTED AT THE GOVERNMENT PRINTING OFFICE, SINGAPORE,
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1957

CONTENTS

		Paragraphs
I.	General	1–2
II.	Staff	3–10
III.	Meteorological	11–13
IV.	Botanical Work and Herbarium	
	(i) Collecting	14–19
	(ii) Exchange and Loan of Herbarium Specimens	20–24
	(iii) Current Research	25–32
V.	Horticultural Work	
	(i) General	33–36
	(ii) Orchids	37–42
	(iii) Succulents	43
	(iv) Plant Sales	44–45
VI.	Advisory Work	46
VII.	Labour	47
VIII.	Buildings and Roads	48–50
IX.	Library	51–52
X.	Band Concerts	53
XI.	Conduct and Gardens' By-laws	54–55
XII.	Gardens' Trainees	56
XIII.	Government House Domain	57–59
XIV.	Kranji War Cemetery	60
XV.	Nature Reserves	61–63
XVI.	Singapore Gardening Society	64
XVII.	Visitors	65–66
XVIII.	Publications	67–70

ILLUSTRATIONS

I. Daily humidity charts at the Singapore Botanic Gardens.

II. *Ploiarium alternifolium* with epiphytic ant-plants.

III. Group of epiphytic ant-plants.

IV. Ridleyara Fascad.

V. Aranthera Anne Black.

VI. Great Frangipanni.

APPENDICES

		Page
I.	Staff of Botanic Gardens, 1956, Division I–III - -	17
II.	Meteorological Records—Gardens' Office - -	18
III.	Meteorological Records—Orchid Enclosure - -	19
IV.	Rainfall Records at the Singapore Botanic Gardens, 1914–56 - - - - -	20
V.	Institutions and Private Collectors from whom Plants and seeds were received in 1956 - - -	23
VI.	Institutions and Private Collectors to whom Plants and seeds were sent in 1956 - - -	24

I. GENERAL

THE PROGRESS reported last year was maintained in 1956. There were no staff changes, but the Government's Malayanisation policy introduced towards the end of the year will result in changes in 1957. The first research worker financed from Colonial Development and Welfare Funds arrived in December.

2. It is with deep regret that the death was recorded on the 24th October, 1956 of Mr. H. N. Ridley, C.M.G., F.R.S. in his one hundred and first year. Mr. Ridley had been Director of the Singapore Botanic Gardens from 1888–1912 and was "the father of Malaya's rubber industry." The Gardens had celebrated Mr. Ridley's centenary on the 10th December, 1955, as was reported in paragraphs 43–47 of the 1955 Annual Report.

II. STAFF

3. In a small department such as the Botanic Gardens, difficulty is experienced when senior members of the staff go on vacation leave, as those officers remaining must take over additional duties and responsibilities to those which they normally perform. Mr. J. Sinclair, Keeper of the Herbarium was away from Singapore from 29th February–13th October on vacation leave in Europe. Although no study leave was taken, Mr. Sinclair spent a considerable time working at the Herbaria of Florence, Munich, Geneva, Leiden, Kew, the British Museum and Edinburgh. Dr. C. X. Furtado, Botanist, was in charge of the Herbarium during Mr. Sinclair's absence. Mr. J. W. Ewart, Curator, left for annual vacation leave in New Zealand on 26th January and returned on 10th March. Mr. H. M. Burkill acted as Director from 15th May–13th June, while Mr. Purseglove was away on duty in Sarawak.

4. Mr. Chew Wee Lek, a graduate of the University of Malaya, was appointed Botanist on 1st October. Mr. Chew will proceed overseas for post-graduate study in 1957; in the meantime he will carry out preliminary research in Singapore. Dr. C. X. Furtado, a re-employed pensioner continued in the post of Botanist, the title having been changed from that of Assistant Botanist. Dr. Furtado has agreed to remain on the staff until Mr. Chew returns to Singapore in 1959.

5. The post of Assistant Librarian was up-graded to Librarian, but was vacant for most of the year, until Mrs. Lynas was appointed temporary Librarian on 1st October.

6. Mr. A. G. Alphonso, Horticultural Assistant, returned to Singapore on 2nd December after two years' training at the Royal Botanic Gardens, Kew, where he obtained the Kew Diploma.

7. The British Empire Medal was conferred by Her Majesty the Queen in the Birthday Honours on Inche Ahmad bin Hassan, who has now completed fifty-five years service in the Department. Inche Ahmad, who was first employed by Mr. Ridley as a Plant Collector in 1901, has rendered meritorious service to the Botanic Gardens during his long period. He is still very hale and hearty and his great knowledge of local plants is a very valuable asset to the Gardens.

8. There was no change in the office staff during the year. On the field side, Inche Ngadiman bin Haji Ismail was promoted from Plant Collector to Head Ranger, Nature Reserves on 1st January and the three new appointments of Rangers to supervise the Reserves were filled on 1st June. Inche

Mohamed Shah bin Haji Mohamed Nur was appointed Plant Collector on 1st January, having spent the previous year as a daily-paid labourer learning this work.

9. Mr. Purseglove attended a Symposium on the "Vegetation of the Humid Tropics" arranged by U.N.E.S.C.O. in Ceylon in March. The Director acted as Chairman of the Committee on Animal and Vegetable Life and Resources of the Pan-Malayan Scientific Advisory Council during the year. He was Chairman of the Singapore Branch of the Malayan Nature Society, Vice-President of the Gardening Society, and a member of the Court of the University of Malaya.

10. A list of the staff of the Botanic Gardens, Division I–III, is given in Appendix *I*.

III. METEOROLOGICAL

11. A new meteorological station was set up in the Orchid Enclosure in January. The Singapore Meteorological Office very kindly supplied the following instruments:— maximum and minimum thermometers, wet and dry bulb thermometers, recording thermograph, recording hygrograph, rain gauge, recording rain gauge which records density of precipitation, sunshine recorder, solar radiation thermometer, grass minimum thermometer, three earth thermometers for the depths of four inches, one foot and four feet and a Stevenson screen. It was thus possible to extend considerably the data on local climatic conditions, which is of great importance to the study of plant growth and especially the time of leaf fall and flowering. The records for the new station taken at 8 a.m. are given in Appendix *III*, while those for the old station, where readings continued at 9.30 a.m., are given in Appendix *II*. These may be summarized as follows:—

	Gardens' Office	*Orchid Enclosure from 21-1-56*
Total Rainfall	105.17 in.	100.25 in.
Highest Fall in 24 hours	4.33 in.	4.00 in.
No. of days on which rain fall	201	202
Average Rainfall 1914–56	100.00 in.	—
Mean Maximum Temperature	86.3°F.	85.7°F.
Highest Maximum Temperature ..	92.8°F.	91.8°F.
Mean Minimum Temperature	74.1°F.	73.3°F.
Lowest Minimum Temperature ..	70.2°F.	69.0°F.
Mean Temperature Dry Bulb	80.1°F. at 9.30 a.m.	75.4°F. at 8 a.m.
Mean Temperature Wet Bulb	76.4°F. at 9.30 a.m.	74.9°F. at 8 a.m.
Mean Relative Humidity	83.5% at 9.30 a.m.	96.1% at 8 a.m.
Mean Minimum Grass Temperature ..	—	70.7°F.
Mean Earth Temperature 4 in. ..	—	80.3°F.
Mean Earth Temperature 1 ft. ..	—	82.6°F.
Mean Earth Temperature 4 ft. ..	—	83.1°F.
Mean Daily Hours Sunshine	—	4.2
Mean Solar Radiation	—	137.3°F.

12. The rainfall for the year was slightly above the average, but was fairly typical of this seasonless climate. July and November were unusually wet. Although the two stations are only about a quarter of a mile apart, the daily readings show some variation, as storms in Singapore are often exceedingly local. Three graphs from the hygrograph are figured in Plate I. During days of heavy rain when the sky is continuously overcast, humidity remains at saturation point, while in fine sunny weather humidity gradually drops to 60–70 per cent at mid-day and gradually rises during the afternoon to over 90 per cent during the night.

13. The total monthly and annual rainfall at the Gardens from 1914, when the first records were begun, until 1956 are given in Appendix *IV*, as well as the average for this period. Many of these figures have not been published previously and those for 1942–6 are of particular interest as they are the only records now available for Singapore during the Japanese interregnum.

IV. BOTANICAL WORK AND HERBARIUM

(i) COLLECTING

14. With the Keeper of the Herbarium away for seven and a half months on vacation leave and being fully occupied for the rest of the year on his study of Malayan Myristicaceæ, collecting by members of the staff was confined largely to the Director and Assistant Director. Besides local collecting on day trips, Mr. Burkill collected in the following areas:—Pulau Satumu, Biola and Senang, 30th March–2nd April and 3rd–7th August (186 numbers); Horsburgh Light, South China Sea, 27th–28th June (27 numbers); Pulau Pisang, Southern end of Malacca Straits, 6th–7th July (31 numbers); Port Dickson, Negri Sembilan, 26th August and 11th–15th September (66 numbers); on local leave at Cameron Highlands, Pahang, 27th August–10th September (152 numbers); Pulau Angsa, Central Malacca Straits, 18th–22nd November (78 numbers); Sungei Buloh, Selangor, 23rd–26th November (103 numbers). On many of these excursions Mr. Burkill collected marine algæ as well as land plants. His visit to the Cameron Highlands included the ascent of Gunong Batu Brinchang, 6,666 feet, now made accessible by a road to the radio station at the summit, where European Gorse (*Ulex europæus*) is now naturalised. Also here was found *Polygonum paniculatum*, a new record for Malaya. In all Mr. Burkill collected 733 numbers, of which 354 were algæ.

15. The Director made small collections at Mersing and Gunong Pulai in Johore and at Fraser's Hill in Pahang, while Mr. Sinclair also made a small collection from Kuantan, Temerloh, Fraser's Hill and Malacca from 19th–22nd October.

16. Mr. Puresglove visited Sarawak for the period 15th May–13th June. The first week was spent making a preliminary investigation of the flora of the newly-established Bako National Park at the mouth of the Sarawak River, where there is extensive heath woodland on the padang, as well as lowland forest on karenga sands. On the very acid, wet, shallow podsolised sands of the padang, overlying the sandstone rock the heath-like shrubs and small trees of *Styphelia malayana, Bæckia frutescens, Ploiarium alternifolium* and *Dacrydium beccarii* were encrusted with epiphytic myrmecophilous plants of *Hydnophytum formicarium, Myrmecodia tuberosa, Pachycentria glauca* and *Dischidia rafflesiana*. A small sundew, *Drosera spathulata*, a new record for Sarawak, was abundant on the peaty soils by the tea-coloured streams, as were *Utricularia* spp. The sundew which is normally confined to open mountain heaths, was growing at 300 feet above sea level. An attractive orchid,

Paphiopedilum hookeræ, was plentiful on Pulau Lakei. Two species of *Loxocarpus,* probably new to science, were discovered in the karenga forests, as well as other novelties.

17. From Bako Mr. Purseglove returned to Kuching and from there proceeded by launch to Tatau, then by *prahu* up the Tatau River to Sana on the Sungei Tau and from there on foot to the Tau Range of mountains, where ten days were spent in little-known country, hitherto unvisited by botanists. As might be expected, many interesting plants were obtained, including a number of known species of which there are no specimens in the Singapore Herbarium, e.g. *Beccarianthus pulcher,* an attractive shrub with large deep pink flowers; new records for Borneo, e.g. *Ficus stricta,* a strangling fig 120 feet high; and many plants which cannot be identified in Singapore, which will include a number of new species, e.g. *Microcasia* sp. nov. One of the most spectacular plants collected was *Rhododendron* sp. (Purseglove 5440), a shrub 5 feet in height growing as an epiphyte 30 feet above ground level on a tree along the Tatau River. This was the only specimen seen. It had an inflorescence of eight very attractive flowers, nearly 4 inches in diameter and salmon pink in colour with a white star in the centre. A living plant was brought back to Singapore and has so far survived. It is certainly one of the most attractive Rhododendrons so far discovered in the lowland tropics. Herbarium material has been sent to Dr. Sleumer of Leiden for determination.

18. In all the Director collected 616 numbers in Sarawak during this visit. With an average of five or six duplicates per number, a total of over 3,000 specimens was brought back to Singapore for naming, incorporation in the Herbarium and for distribution. In addition, a fair number of living plants and seeds were brought back for trial in the Gardens. The Chief Secretary of Sarawak, the Curator of the Sarawak Museum, the Honorary Keeper of the Herbarium and the Conservator of Forests and his staff are thanked for supplying launch transport and for other assistance, without which the expedition would not have been possible.

19. Some new records for individual states of the Malay Peninsula were obtained, as well as a few plants entirely new to Malaya. A lily-like herb collected near Kuala Lumpur by Mr. J. Reid of the Institute for Medical Research was identified by Mr. Sinclair while at Kew as *Chlorophytum laxum,* which has a wide distribution in India, Siam and North Australia, but was previously unknown in Malaya. Another new record was *Canthium cochinchinense,* which had been collected by Mr. Sinclair in Trengganu. Two orchids, *Goodyera hispida* and *Bulbophyllum concinnum,* obtained by Mr. E. F. Allen of the Federation Department of Agriculture on a limestone hill in the Templer National Park were new records for Selangor.

(ii) EXCHANGE AND LOAN OF HERBARIUM SPECIMENS

20. The routine work of drying, poisoning and mounting specimens, as well as the repair of existing sheets, was continued throughout the year. The number of sheets mounted and incorporated in the herbarium was 1,196, a reduction over the previous year, due to the long delay in supplying new mounting paper from Britain and also a lack of cupboard space. The eight cabinets received towards the end of the year are insufficient to house all the material awaiting incorporation and more cabinets are urgently required.

21. The number of specimens received in exchange for duplicates sent out and those donated was 6,768, as compared with 2,451 in 1955. The following institutions and individual are thanked for sending this valuable material:—the Auckland Museum; the British Museum; the Forestry Departments of Brunei, Sarawak, British North Borneo and New Guinea, the Forest

Research Institute, Kepong; the Kebun Raya Bogar; the Rijksherbarium, Leiden; the Arnold Arboretum; H.E. the British Ambassador to Laos—Lord Talbot de Malahide and his successor Mr. L. G. Holliday; Mr. G. H. Pickles—a member of the 1955–6 Oxford University Expedition to Sarawak; Mr. E. F. Allen and Dr. J. Dore of the Federation of Malaya's Agricultural Department; Mr. J. A. le Doux of Kota Tinggi; Mrs. B. E. G. Allen; and Professor H. B. Gilliland. Many gaps in the collection have been filled by these specimens exchanged and donated and they are most useful to the staff engaged on the revision of individual families.

22. The number of herbarium duplicates distributed from the Gardens to other scientific institutions was the highest for many years, namely 5,397 specimens, compared with 2,167 in 1955. Many of these were collected by the Director in Sarawak. The following are the institutions to which material was sent:—the Royal Botanic Gardens, Kew; the British Museum; the Edinburgh Royal Botanic Garden; the Rijksherbarium, Leiden; the Museum National d'Histoire Naturelle, Paris; the Arnold Arboretum, U.S.A.; the National Museum, Manila; the Forestry Departments of Bangkok and North Borneo; the Forest Research Institutes of Kepong and Dehra Dun; the Departments of Agriculture of Bangkok and Brisbane; the Sarawak Museum and the Marine Biological Station, Anglesey. Sorting began towards the end of the year of the very large number of duplicates of specimens collected over the past thirty years by the Gardens' staff, but which had not been named specifically at the time. Wherever possible these are now being named, except for undescribed species, and they will be distributed to other herbaria on an exchange basis in 1957.

23. A total of 4,525 specimens was sent on loan to the authors of *Flora Malesiana* at Kew, Leiden and Bogor, as against 4,903 in 1955. Many specimens which had been on loan previously were returned correctly annotated, thus enhancing considerably their practical value. The number of specimens received on loan by the Herbarium staff was 577 and came from the Herbaria of Bogor, Stockholm, Uppsala and Leiden, to whom our thanks are due. They consisted of palms for Dr. Furtado and Myristicaceæ for Mr. Sinclair. Arrangements were made to borrow specimens of Myristicaceæ from other leading world herbaria and these will arrive in 1957.

24. In addition to the above exchange and loans, living plants, seeds and spirit material were sent at the request of botanists in other countries for special study. The fullest co-operation continued with the Botany Department of the University of Malaya and much material was provided for classwork and research.

(iii) CURRENT RESEARCH

25. Mr. Sinclair, Keeper of the Herbarium, continued his study of Malayan Myristicaceæ. As a result of his studies at the herbaria of Florence, Munich, Geneva, Leiden, Kew, the British Museum and Edinburgh during vacation leave, he gained much information which was not available in Singapore and was able to make many additions and corrections to his original manuscript. The Directors of these herbaria are thanked for their generous help and hospitality to Mr. Sinclair, who benefited greatly from their advice and discussions. Special thanks are due to Professor C. G. G. J. van Steenis of Leiden, the founder and editor of the *Flora Malesiana*. Mr. Sinclair extended his study to the Myristicaceæ of the whole of the Malaysian region. Opportunity was also taken to determine other plants which it had been impossible to name satisfactorily in Singapore.

26. Dr. Furtado, Botanist, continued his study of Malaysian palms. He also sorted and named large collections of plants from Borneo and New

Guinea, as well as smaller collections from Malaya and Laos, which will now be incorporated into the Herbarium. In the course of this work he took the opportunity to indicate on the herbarium specimens the publications in which they and their duplicates had been cited. In this way many specimens from Elmer's Borneo collections were named, correcting some names and indicating isotypes. Opportunity was also taken to name as far as possible many unnamed specimens already incorported into the herbarium in previous years. He answered many queries from the Police, Chemistry, Customs and Agricultural Departments of the Federation of Malaya and Singapore, as well as other bodies and individuals and named specimens of plants and plant fragments submitted.

27. The Director completed his determinations of over 1,100 numbers collected by him in Sarawak in 1955–6, while the Assistant Director named many of his Malayan specimens.

28. Mr. Burkill, the Assistant Director, sorted and arranged the algological collection, comprising 1,071 sheets, according to Fritch's system of classification. Many of the original collections of Setchell and Gardner are represented by co-type sheets. A marine green algæ collected by Mr. Purseglove at Mersing was found to be *Acetabularia crenulata,* a new record for Malaysia. Apart from this record and one from Ceylon, this algæ has only been collected in the Caribbean region.

29. Mr. Chew Wee Lek, Botanist, has begun a taxonomic study of certain Malayan genera of Moraceæ.

30. Dr. G. A. Prowse, Botanist/Algologist of the Malacca Fish Culture, Research and Training Institute continued his research on Malayan fresh-water algæ at the Botanic Gardens until he transferred to the new station at Malacca in May. He made many interesting discoveries among the algæ in the Gardens' lake and elsewhere on the Island.

31. Dr. P. B. Tomlinson, who spent a year at the University of Malaya and the Gardens studying the systematic anatomy of palms and Musaceæ, left in June. He has now been appointed to the staff of Achimoto University College, Gold Coast. Mr. T. C. Whitmore, a Ph.D. student of Cambridge University, arrived in December. He is receiving a Colonial Development and Welfare Grant and will study the anatomy of the bark of Dipterocarpaceæ in relation to taxonomy as part of his work for his doctor's thesis.

32. The Director co-operated with Dr. Bryce Douglas and Dr. Kiang Ai Kim of the University of Malaya, who are carrying out a phytochemical survey of Malayan plants. Dr. Bryce Douglas, a Visiting Research Associate of the Chemistry Department of the University of Malaya, arrived in September and is to spend two years in Singapore financed by the Smith, Kline and French Laboratories of Philadelphia. The preliminary screening for alkaloids has already produced some interesting results.

V. HORTICULTURAL WORK

(i) GENERAL

33. The Gardens were kept in good condition during the year. Good service was obtained from the motor mowers, but during periods of prolonged wet weather the heavy Dennis mowers could not be used. It is hoped that use can be made of the Hayter mowers on soft ground. Much of the time of the general labour force was occupied in clearing away uprooted trees. Some of these were old and moribund, but others were in vigorous growth, the damage usually occurring during strong gusts of wind when the

soil was saturated with rain. Composting was continued on the same scale as last year. Unfortunately the compost heaps on the various lawns provided an ideal breeding place for the Rhinoceros Beetle (*Oryctes rhinoceros*) which is causing so much damage to coconuts and other palms in Singapore. It is hoped that by collecting and destroying the larvæ when the heaps are turned and examined every six weeks, together with the use of insecticides, that some measure of control will be possible. It was found that breeding was diminished when grass or other vegetation had grown on the heaps.

34. Advantage was taken of the unusually low level of the lake during the construction of the retaining wall to root out the lotus (*Nelumbium speciosum*), *Hydrilla ovalifolia* and *Enhydrias angustipetala* which threatened to swamp the water lilies and other water plants. The Sago palms near the main gate on lawn *A* were cut back and the thicket round the lake outlet was cleared. Several clumps of bamboo and trees of *Eugenia grandis* and *Fagræa fragrans* were removed from the lake edge on lawn *F* to permit a vista across the lake from lawn *J*. The trees overhanging Cluny Road and Tyersall Avenue were cut back to the boundary. The quality and quantity of the pot plants have improved greatly since their transfer to the orchid enclosure.

35. Three large round beds were made on the bandstand terrace above the tea kiosk and planted with *Duranta ellisii, Cassia auriculata* and *Stenolobium stans*. Other new beds included *Clerodendron paniculatum* to the east of the pergola, *Calliandra emarginata* at the junction of Lower Ring Road and Office Gate Road and *Randia macrantha* under-planted with *Orthosiphon stamineus* above the sun-dial terrace. Sections of seven different hedge plants were planted alongside the orchid enclosure for trial and demonstration purposes; they were *Acalypha siamensis, A. sanderiana, Cordia cylindristachya, Ehretia microphylla, Eranthemum malaccense, Mussænda luteola* and *Randia spinosa*. Borders faced with dressed coral were constructed along both sides of the pergolas at the plant house and plants bedded out in them include *Begonia coccinea* vars., *Citharexylum quadrangulare, Cuphea ignea, Gloxinia maculata, Lantana camara, Nepenthes ampullaria, N. gracilis, Rhododendron javanicum* × *indicum, Rhœa discolor* and *Strobilanthus dyerianus*. New creepers planted on the pergola were *Raphistemma pulchellum, Stephanotis floribunda* and *Urceola brachysapala*. The creeper *Camœnsia maxima*, transferred to a more exposed position in 1955, has flowered freely during the year.

36. The most notable introduction during the year was the Bougainvillea Golden Glow, with apricot coloured flowers, which has grown and flowered well. Among the species new to the Gardens planted out during the year were *Podocarpus koordersii, P. teysmanii* and *Talauma hodgsonii* on lawn *C*, an hermaphrodite nutmeg (*Myristica fragrans*) on lawn *D*, *Pterocarpus echinata, P. rohrii* and *P. vidalianus* on lawn *E*, and *Amorphophallus titanum* on lawns *T* and *X*. Some of the foliage plants, including species new to science, introduced by the Director from Sarawak, show promise. Losses occurred in the Gardens during the year, but did not include any species which are irreplaceable.

(ii) ORCHIDS

37. The Gardens' collection of orchid species and hybrids, which were transferred to the new orchid enclosure early in 1955, continued to show better growth and flowering than on the old site at the Director's house. By the end of 1956 all the orchid seedling houses had also transferred to the new enclosure and the seedlings have benefited, as the site is more open and permits a better circulation of air. It has also been possible to dispense with the wire-netting round the houses, as the monkeys have learnt to respect

the electric fence. By concentrating all the orchid work in the one area, more adequate supervision is possible, the time and labour of those tending the orchids are saved, the transport of seedlings is reduced and the orchids are more secure. The latter is extremely important because of the large number of orchid thefts which has occurred in Singapore during the year. Private growers have lost many valuable plants, while the Gardens lost 36 seedlings of a valuable and promising cross before the seedlings were transferred to their new quarters. Three of our best Vanda Tan Chay Yan plants and two Dendrobiums, which were on display in the plant house, were stolen in August. The police have not been able to trace the culprits, but it is obvious that those responsible have a considerable knowledge of orchids. Because of these thefts it is no longer possible to display valuable orchids in the plant house and so the public is deprived of seeing them at close quarters. This is particularly disappointing to the many tourists who visit the Gardens, some of whom come specifically to see the orchids. It is regretted that our best orchids cannot be displayed to the public until such time as the Gardens are enclosed by security fence and new gates provided or until the plant house is rendered thief-proof.

38. The simplified technique of planting the Arachnis, Arandas, the terete and semi-terete Vandas and other orchids normally grown in beds, is proving very satisfactory. This consists of merely stripping off the turf, driving in the stakes about 15 inches apart, tying the plants to the stakes so that their roots just rest on the surface of the soil and then building a mixture of half-rotted compost and manure round the plants to a height of 9 inches. By using this method no digging is done at all and the plants seem to thrive equally well, thus effecting a great saving in cost, time and compost. The cultivation of the seedlings in the sterilised medium with Vacin's formula in the flasks in the laboratory was continued. Experiments were begun using coconut water (the liquid inside the nuts), both from immature and mature nuts, with the medium and it has produced very spectacular results. It is known that the coconut water contains a growth-promoting substance and it has speeded up the early growth of the seedlings to a remarkable degree. These experiments are continuing.

39. Many exchanges of orchids were arranged with institutions abroad, as well as local growers. A large selection of Vandas and Dendrobiums was received on an exchange basis from Messrs. William Kirch of Honolulu. Messrs. T.M.A. Orchids of Singapore gave a selection of their new seedlings in exchange for some of ours. Among the plants received were a good variety of Aranthera James Storie, Dendrobium Edythe Pung, D. Grace Goo, D. Gouldii, *Vanda cærulea,* Vandænopsis Khoo Kay Ann, V. Prosperitas and Vandanthe Colorsan. With more orchids of Hawaiian origin in the collection, especially those with *Euanthe sanderiana* strain in them, and crossing these with our good Singapore hybrids, some outstanding new hybrids should be produced.

40. During the year 240 crosses were made, of which 88 produced seeds. These have now been sown. The number of new orchid hybrids which flowered in 1956 was 48 and many of these have now been registered. They include the following:—Arachnis Capama (A. Maggie Oei × *A. breviscapa*), A. Maroon Maggie (A. Maggie Oei × *A. flos-aris var. insignis*), *Aranda* Amy Braga (Vanda Gilbert Triboulet × Arachnis Maggie Oei), A. Anne Braga (*Arachnis hookeriana* × *Vanda cooperi*), A. Bertha Braga (*Vanda tricolor* × Arachnis Maggie Oei), A. Eng Lan (Arachnis Maggie Oei × Vanda Rose Marie), A. Freckles (Arachnis Ishbel × *Vanda dearei*), A. Louise Wong (Arachnis Maggie Oei × *Vanda sumatrana*), A. Mauve Star (*Arachnis hookeriana* var. *luteola* × Vanda Flammerolle), A. Myrna Braga (Arachnis Ishbel

× *Vanda merrillii*), A. Pink Pearls (*Arachnis hookeriana* var. *luteola* × Vanda Gilbert Triboulet), Arandanthe Wendy Scott (*Arachnis hookeriana* var. *luteola* × Vandanthe rothschildiana), Aranthera Anne Black (Arachnis Maggie Oei × *Renanthera coccinea*), A. Bloodshot (Arachnis Ishbel × *Renanthera coccinea*), Dendrobium Abigail (D. Pauline × *D. veratrifolium*), A. Ang Swee Kim (D. Pauline × D. Tan Chye Siam), D. Kehaulana Ayau (D. Bali × *D. phalænopsis*), D. Liliha (*D. phalænopsis* × D. Pauline), D. Mustard (D. Ursula × D. Champagne), D. Purple Veins (D. Varsity × *D. phalænopsis*), D. Syaj (D. Caesar × D. Constance) D. Tumphal (D. arcuatum × *D. phalænopsis*), D. Yellow Curls (D. Champagne × *D. undulatum*), Ridleyara Fascad (Aranda Eileen Addison × *Trichoglottis fasciata*), Vanda Memoria Alex Donald (V. Josephine van Brero × V. Prolific), V. Rubella (V. Ruby × V. Prolific), Vandænopsis Kapden (Vanda Kapoho × *Phalænopsis denevei*), V. suavi (Vanda tricolor × *Phalænopsis denevei*), Vandanthe Kewalo (Vandanthe Ellen Noa × *V. luzonica*), V. Manisaki (Vanda Memoria T. Iwasaki × Vandanthe Manila).

In the above list the female parent is always given first, the species used are given in italics and hybrids in ordinary type.

41. Of the above hybrids Ridleyara Fascad is undoubtedly the most interesting and is the first trigeneric cross to be raised at the Gardens. It is also the first cross to flower in which Aranda was used as a parent; most other Arandas do not produce viable seed. Its parentage is as follows:—Vanda Kapoho × Arachnis Maggie Oei (both hybrids)=Aranda Eileen Addison × *Trichoglottis fasciata*=Ridleyara Fascad. It is named in honour of Mr. H. N. Ridley and this was some of the last information to enter his consciousness before he died. One of the most promising hybrids to flower during the year was Aranthera Anne Black, named in honour of Lady Black, wife of H.E. the Governor of Singapore. It is similar to A. James Storie, but has larger flowers, longer and denser sprays and is very free flowering. Aranda Myrna Braga should prove useful for the cut flower market. It has long sprays of yellow flowers heavily mottled with rich brown; it is very free flowering and may produce as many as five sprays simultaneously. Arandanthe Wendy Scott is a very fine hybrid with flowers of an unusual shade of mauve pink. The first seedling of the cross to flower has proved to be the best and flowers every two months, bearing two to three spikes. The two best new Dendrobiums are D. Purple Veins, which shows considerable variation, but the best seedlings are medium purple with prominent darker veins, and D. Ang Swee Kim, of which one seedling has the darkest purple flowers yet raised in Singapore. The best Vanda-type hybrids are Vanda Memoria Alex Donald which is free flowering and has large heads of peach coloured flowers and Vandanthe Kewalo which has similar colouring to *Vanda luzonica*, but without the shy blooming habit and twists in the flowers of the parent. This cross was first made in Hawaii, but has been raised subsequently at the Gardens.

42. The Malayan Orchid Society was resuscitated during the year and is now producing a number of the *Malayan Orchid Journal*, in which descriptions of the new orchid hybrids will be published. During the past two years these have appeared in the *M.A.H.A. Magazine* of the Malayan Agri-Horticultural Association.

(iii) SUCCULENTS

43. Although the succulent collection was not greatly enlarged in number of species, many of the established plants were grown to a larger size and were propagated. Aloes and Agaves, which at the beginning of the year were

in 4-inch pots, were transferred to 8-inch pots and have grown remarkably well. Although a second succulent house was built, this is now full and more accommodation is required. The keen interest among local growers continued and once again it was found impossible to meet all the demands for the purchase of succulents.

(iv) PLANT SALES AND EXCHANGE

44. The revenue from the sale of plants during the year was $27,245, compared with $22,187 in 1955 and an increase of 55 per cent over the 1953 sales. The major proportion of the revenue of $22,759 came from the sale of orchids, comprising 352 plants, 558 cuttings and 2,536 seedlings, a total of 3,446. A total of 426 succulents was sold for $478, while 25,666 sales of other plants produced $4,008, a reduction over the previous year. Some 3,198 plants and cuttings were supplied free to Government institutions and schools.

45. Planting material distributed on an exchange basis, mainly to botanical institutions overseas, consisted of 368 packets of seeds and 102 plants and cuttings. In return the Gardens received 575 packets of seeds and 322 plants and cuttings, including gifts. Those institutions and individuals who provided this valuable materials are listed in Appendix *V* and we are most grateful to them, while those to whom we sent seeds and plants are given in Appendix *VI*. The number of pot plants loaned to Government Departments during the year was 1,643.

VI. ADVISORY WORK

46. Numerous schools and other Government institutions were visited during the year and advice, plans and planting material were supplied free of charge. The assistance of the Department is constantly being solicited in this way, a task which it does its best to fulfil. In addition to these, many requests were received from private individuals seeking advice. The Department has co-operated fully with the Public Works and other Departments and the principal work which it has planned and provided planting material for is as follows:—Nicoll Drive, Buona Vista Park, Pasir Panjang Park, the dual carriage way on Bukit Timah Road, the Land Development Unit at Tanjong Rhu, the Police Cantonment at Mount Vernon, the new Probationary Nurses Hostel at the General Hospital, the Teachers Training College, Paya Lebar Airport, New Fire Brigade and Ambulance Station at Bukit Timah Road, Coroner's Court in Outram Road, No. 10 Ridley Park, Tan Tock Seng Hospital, Fort Canning Park and Raffles' Statute in Empress Place. Details of this work and the lists of plants provided would take up too much space and be repetitive. Two examples only will be quoted. In addition to the 370 trees provided for Nicoll Drive in 1955 the following were also supplied in 1956:—48 Royal Palms, 44 *Terminalia catappa*, 17 Tamarind, 6 *Peltophorum* and 2 *Adinanthera*. The following were provided for the Police Cantonment at Mount Vernon:—31 *Acacia*, 17 *Millettia*, 12 *Adinanthera*, 12 Madras Thorn, 11 Rain Trees, 11 Yellow Flames, 11 *Filicium*, 11 Mahoganies, 10 *Muntingia*, 9 *Casuarina sumatrana*, 8 *Eugenia grandis*, 8 *Andira* and 7 *Plumeria*. It can thus be seen that the Gardens Department continues to play a very active part in planning the amenities of the Colony and in helping to make it as beautiful as possible.

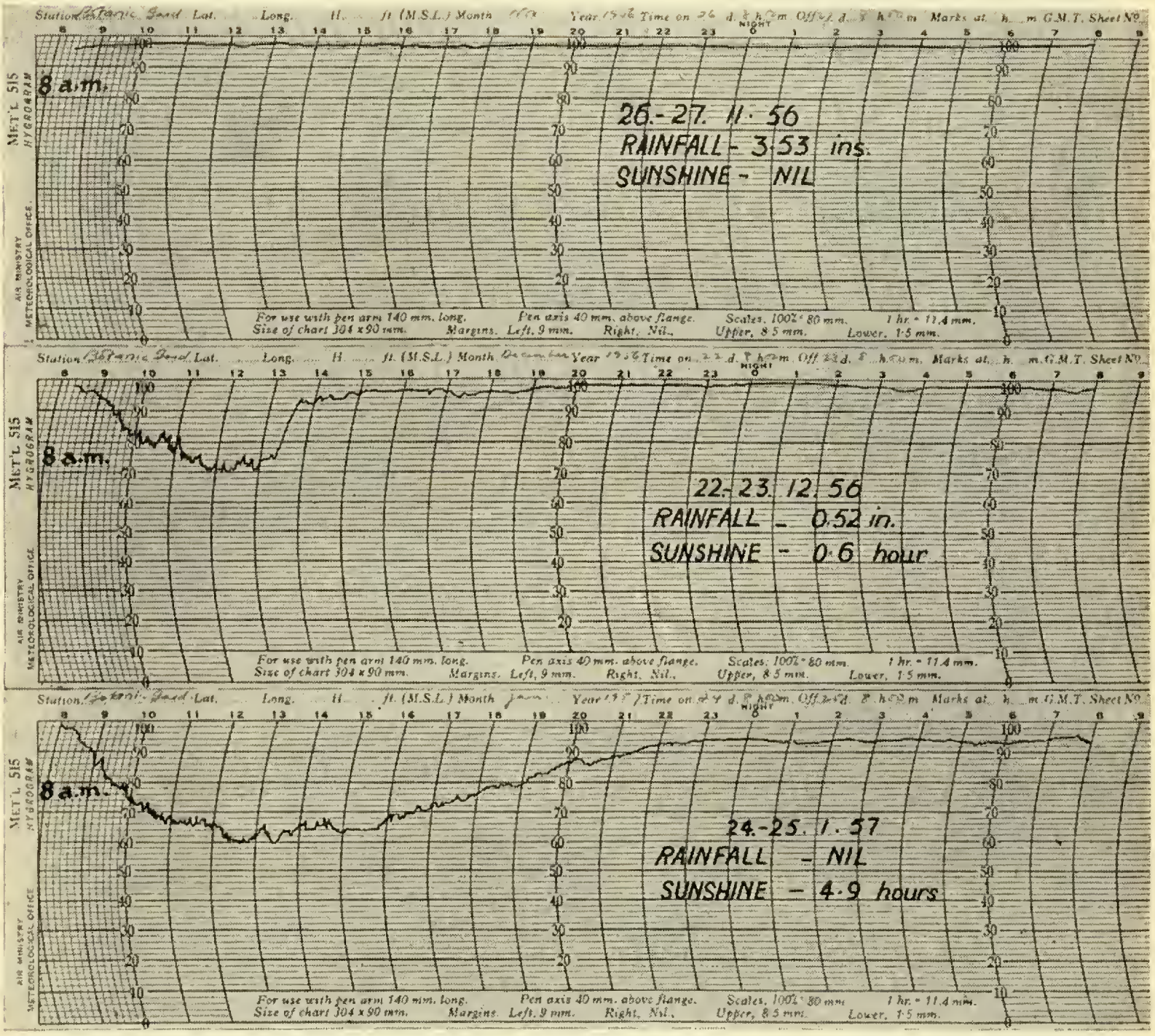


PLATE I—Daily humidity charts at the Singapore Botanic Gardens.

J. W. Purseglove

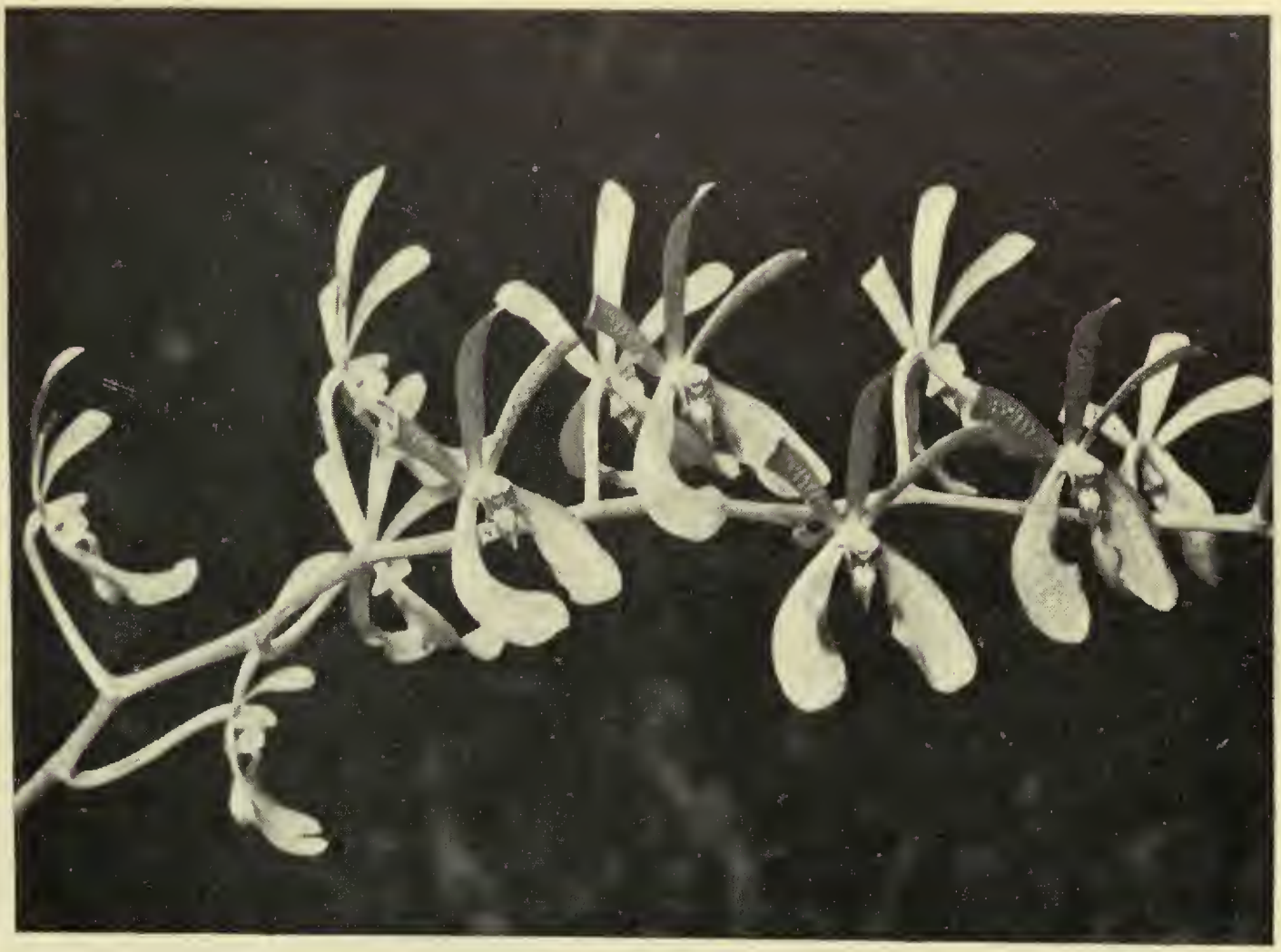
PLATE II—*Ploiarium alternifolium* with epiphytic ant-plants in the Bako National Park, Sarawak.

J. W. Purseglove

PLATE III—Group of epiphytic ant-plants growing on *Cratoxylon glaucum* in the Bako National Park. They include *Hydnophytum formicarium, Myrmecodia tuberosa* and *Pachycentria glauca.*

G. H. Addison

PLATE IV—Ridleyara Fascad, the first trigeneric orchid to be raised and flowered at the Singapore Botanic Gardens.



G. H. Addison

PLATE V—Aranthera Anne Black (Arachnis Maggie Oei × *Renanthera coccinea*), which flowered for the first time in 1956. It is named in honour of Lady Black, wife of H.E. the Governor of Singapore.

G. H. Addison

PLATE VI—Great Frangipanni (*Plumeria obtusa*).

VII. LABOUR

47. With four members of the daily-rated labourers transferred to the Upkeep of Herbarium vote on the 1st January, the average strength of daily-rated force at the Gardens was 74. A total of 226 man-days was lost on account of sick leave supported by certificates, while an even greater time was lot by men visiting hospital and not being certified sick or by taking their families for medical treatment. Wages amounted to $106,619 during the year. The rates of pay remained unchanged. The daily labour force in Government House Domain averaged 56.

VIII. BUILDING AND ROADS

48. No major work was done on roads, paths and drains during the year, except for the road in the orchid enclosure which was reduced to 12 feet and new drains were constructed. The new flame gun was found suitable for controlling weeds in the paths and drains, with the exception of nut-grass (*Cyperus rotundus*). A granite retaining wall, approximately 636 feet in length, was constructed round the lower end of the lake by the Public Works Department. This is a great improvement as the grass banks were giving way in places and were unsightly and dangerous, as well as providing breeding places for mosquitoes. A path was made above the wall. At the same time the Gardens' mason re-constructed the overflow channel and built a new pipe line to drain the lake, setting it 3 feet lower than the old one, which will thus permit the lake to be more efficiently weeded. The bridge over the lake outlet was repaired and provided with *tembusu* posts and railings. Part of the lake bank on lawn *F* was faced with split nibong (*Oncosperma tigillaria*). The derelict shelter on lawn *E* was demolished as it was unsightly and serving no useful purpose.

49. The pergola on the east side near the plant house was completed in November. It was constructed of tanalised *kempas* (*Koompassia malaccensis*) and the cost, including treatment, was rather less than half that of west side which had been built of *chenghai* (*Balanocarpus heimii*) in 1955. The *chenghai* on the plant-house side was untreated, while the other half, nearer the office, had been brushed with solignum. It will be of interest to compare the durability of these timbers. By this work the plant house and environs, which are such a prominent feature of the Gardens, have been vastly improved. Work still remaining to be done there includes the construction of a water-lily pond in the centre of the *Zoysia* lawn and a new tank for mixed water plants at the south end. The pergola on the band-stand terrace collapsed during a storm in April and is now being re-built.

50. Two of the orchid seedling houses on lawn *X* below the Director's house were demolished and rebuilt inside the orchid enclosure, together with two new houses, one for orchids and the other for succulents. More benches were set up for flowering potted plants on lawn *P* within the enclosure.

IX. LIBRARY

51. Mrs. Lynas was appointed as temporary Librarian on the 1st October. With no Librarian on duty for most of the year only care and maintenance can be recorded. Hand poisoning of books and periodicals was continued throughout the year. Damage by beetles continues to a lesser extent, particularly on books still housed, through lack of space, in the herbarium and offices. Depredation among the more valuable books housed temporarily

in the new air-conditioned building was slight. About one quarter of the bound volumes and an ever-growing quantity of new literature are still improperly housed and constantly subject to insect infestation. A new library building large enough to hold all the books, and with ample space for future acquisitions, is urgently required. New books and periodicals can then pass straight into it without being contaminated. A great many volumes still await binding or re-binding. The library, which has one of the finest collections of old botanical literature in South-East Asia, contains many very valuable works and much literature which is irreplaceable. It is essential that it should be properly housed and adequately cared for.

52. Acquisitions during the year comprise 25 books and 11 periodicals by purchase and 119 periodicals and 143 reprints obtained by exchange agreements for the *Gardens' Bulletin* and *Annual Report*. Exchange arrangements now exist with 160 scientific institutions.

X. BAND CONCERTS

53. During the year twenty-two concerts were given between 5–6.15 p.m. on Sundays by the military bands on duty in Singapore. The concerts continue to be extremely popular and very large crowds have attended. The bands of the following regiments performed:—the 1st Bn. the Royal Lincolnshire Regiment; 1st Northern Rhodesian Regiment; 1st Bn. the Queen's Royal Regiment; 1st Fijian Infantry Regiment; 2nd Bn. the Royal Welch Fusiliers; 1st Bn. the King's Own Scottish Borderers; 1st King's Dragoon Guards; 15/19 the King's Royal Hussars; 1st Bn. the South Wales Borderers; 2nd Bn. Royal Australian Regiment; 1/6 Gurkha Rifles (Pipes and Drums); 2 KEO Goorkhas. The Commanding officers of these regiments and the bands are thanked for providing excellent performances, as is Major-General D. D. C. Tulloch, C.B., D.S.O., M.C., by whose courtesy they are given. Col. Collyer is thanked for arranging them.

XI. CONDUCT AND GARDENS' BY-LAWS

54. Considering the very large number of people who visit the Gardens daily, damage by the public is comparatively slight. Nevertheless, there has been an increase in petty pilfering this year, people damaged plants by carving on them, and irresponsible hooligans on bicycles continue to ignore notices and flaunt authority wherever possible. At the Chinese New Year, despite a general prohibition by the Police, the Gardens were rendered hideous by the constant detonation of fire crackers. Although it was the year of the monkey which was being ushered in, the wild monkeys in the Gardens were terrified and fled to the tops of the tallest trees in the Gardens' jungle or escaped to the comparative security of neighbouring Tyersall. For two whole days the bombardment continued during which plants were damaged, a thick litter of exploded crackers and other refuse littered the Gardens, and much inconvenience was caused to law-abiding citizens. Later in the year two men were caught trapping birds using a Straits robin as a decoy in a cage and sticks with bird line.

55. Three new Security Guards were engaged towards the end of the year and it is hoped that they will be able to restore better conduct among the small minority of visitors who mis-use the Gardens. The situation is rendered difficult, however, by the fact that new Gardens' By-Laws are urgently required and these cannot be promulgated, as the governing principal legislation, the Raffles Society Ordinance of 1878, is still under revision.

XII. GARDENS' TRAINEES

56. During the year nine trainees were accepted from the Rehabilitation Section of the Labour Department for a six months' course of training.

XIII. GOVERNMENT HOUSE DOMAIN

57. The grounds were maintained in good condition throughout the year and regular manuring, spraying and pruning was carried out. On Saturday, the 31st March, a terrific storm centred over and about the Domain. It was only of short duration, about 15 minutes, but it left a trail of devastation in its wake, No less than 14 trees were blown down, some of them very large and in no way considered dangerous, while branches were stripped off and shrubs were damaged. The biggest loss was the very fine specimen *tembusu* (*Fagræa fragrans*) near to the entrance to the Chief Secretary's drive. The other trees blown down were 6 *tembusu*, 2 *Spathodea*, 2 *Jacaranda*, 1 *Eugenia grandis*, 1 *Albizzia*, 1 *Millettia*, and 1 Clove Tree. Attempts to burn out a large hornets' nest in an oil palm in the Chief Secretary's garden resulted in setting fire to the tree and the fire brigade had to be called to put out the conflagration.

58. A fountain, using a $\frac{1}{4}$ h.p. engine, was added to the pool, which was redesigned last year in front of Government House. The hedge of *Baphia nitida* near the second gate has grown well and now forms a perfect screen. *Baphia* is not normally quick growing, but with plenty of care and ample supplies of manure, this hedge has grown up to 6 feet in just over a year. Much of the low-lying area near the main gate was levelled, so that the motor mowers can now work more efficiently. In the avenue between the two gates, the *Arfeuillia* trees are being removed as they become old and moribund and are being replaced by Madras thorn (*Pithecellobium dulce*). To add colour to this part of the Domain beds of *Bougainvillea formosa, B. poultoni,* B. Beauty of Singapore and *Stenolobium stans* were planted. Among the vegetables supplied regularly from the nursery were bayam (*Amaranthus tricolor*), long beans, brinjals, spring onions, mint, parsley, lady's fingers, lettuce, watercress and cucumbers. Orchids, *Helianthus*, Gerberas, Gladioli and Cannas are among the species grown for cut flowers. In replanting the Cannna beds throughout the domain it was found that compost in which horse manure was used produced better results than that with cow manure.

59. The Curator paid regular visits to the Governor's cottage at Changi and a certain amount of work on the garden was carried out by Government House staff. The lawns were maintained by the Public Works Department, which is officially responsible for the house and grounds.

XIV. KRANJI WAR CEMETERY

60. The Department continued to supervise the horticultural work at the Imperial War Graves Commission's Cemetery at Kranji. This entailed much extra work as it was important to get the cemetery in good condition in readiness for the official opening on the 2nd March, 1957. Following the trials with the lawn grasses *Digitaria didactyla, Cynodon dactylon* and *Zoysia* sp., the last named was found to be the most satisfactory. A nursery of one-eighth of an acre was laid down and when sufficient material was available, a further area of half an acre was established. By the end of the year much of the central area of the cemetery had been turfed with *Zoysia* and the remainder with *Axonopus compressus*. There are over 4,000 graves in the

cemetery, which commemorates some 28,000 people who lost their lives during the last war. The headstone borders of all plots on either side of the central avenue were planted using *Crossandra undulifolia, Galphimia glauca, Mussænda luteola, Gerbera jamesonii, Hemigraphis colorata, Portulacca grandiflora* and *Chlorophytum* sp. The side tables of the approach road were planted with *Lagerstrœmia speciosa* and *Filicium decipiens* and the Chinese memorial area was enclosed with a hedge of *Gardenia florida.*

XV. NATURE RESERVES

61. The Board of Trustees of the Nature Reserves held three meetings as follows:—14th March, 30th July and 9th November. Mr. Purseglove, Director of the Botanic Gardens was *ex-officio* chairman throughout the year, while Mr. M. W. F. Tweedie (Mr. C. A. Gibson-Hill acted during Mr. Tweedie's absence during vacation leave), Professor H. B. Gilliland and Mr. A. L. B. Swaine continued to serve during the period under review. Mr. Yap Pheng Geck resigned on 28th February and was replaced by Mrs. A. Ede; Mr. E. Galistan and Inche Yusof bin Ishak were appointed on 26th June to take the place of appointees of the Legislative Assembly, who resigned in 1955. A member of the staff of the City Council's Water Department was invited to attend the meetings.

62. With the employment of three new Rangers from mid-year, in addition to the Head Ranger, closer supervision was possible in the Bukit Timah and Kranji Reserves. Due to lack of a reliable boat and insufficient staff in the Pandan Mangrove Reserve, adequate supervision was not always possible in this area where thefts of timber continued on a small scale. It is hoped to purchase a new boat and to employ labourers in this reserve in 1957. A number of arrests for thefts of timber were made in the Water Catchment Area by the Rangers of the City Water Department, but on being brought to court more than half the cases were discharged and in most of the others only nominal fines were imposed, an insufficient deterrent to future felons. Seven labourers were employed throughout the year at Bukit Timah and two at Kranji maintaining paths and boundaries and patrolling. Path signs have been put up at nearly all the path intersections and a revised map of Bukit Timah was produced.

63. Steps have been taken to excise about 90 acres of the Pandan Reserve which are now farmed as prawn ponds, while a prawn pond in the south of the area will be dismantled. Despite assurances given in the past, quarrying continues at all the quarries on Bukit Timah. Although work is confined to within the quarry boundaries, the boundary path at one point has become unsafe owing to undermining. The Bukit Timah bungalow within the Nature Reserves remains crown land under the control of the Land Office. It is hoped that this may come under the control of the Nature Reserve Board so that the public may continue to enjoy one of the finest vantage points of the island.

XVI. SINGAPORE GARDENING SOCIETY

64. The Society had a successful year and membership continued at approximately 250. Several of the monthly meetings were held at the Botanic Gardens when emphasis was placed on practical instruction and demonstrations. Mr. J. W. Ewart was Secretary for the year 1955–6 and during the following year has taken on the additional duty of Treasurer. The annual flower show held at the Happy World Stadium from 13th–15th April maintained its usual high standard. Mr. G. H. Addison and Mr. J. L. Pestana

were Honorary Show Manager and Assistant Show Manager respectively and several members of the Gardens' staff acted as judges. The Gardens staged a non-competitive group of orchid hybrids and a small model garden. Government House Domain won a number of prizes in the open classes of the flowering and foliage plant sections and the prize money was distributed among the staff. Although the Gardens do not compete in the general classes, they were awarded the cups for the best Dendrobium in the show for D. Neo-Hawaii and for the new Dendrobium raised in Malaya for D. Louise var. Elegance.

XVII. VISITORS

65. The Gardens continue to be very popular with the public and many local inhabitants, as well as visitors to Singapore come to see them. On fine Sundays and holidays several thousands of people visit the Gardens in one day. Among the distinguished visitors from overseas who were taken round by the Director or members of the staff were:—Mr. R. R. Panje, Botanist, Sugar Cane Institute, Coimbatore, Professor J. R. A. McMillan, Dean and Professor of Agriculture, Sydney University, Mr. L. L. Forman, Royal Botanic Gardens, Kew, Dr. Anthony Steel, Principal, University College, Cardiff, Messrs. W. E. Purnell and Smid of U.N.E.S.C.O. South-East Scientific Office, Djakarta, Indonesia, Dr. C. A. Krug, Director, Instituto Agronomico, Campino, Brazil, Mr. Anwari Dilmy, Curator of the Herbarium Bogor, Indonesia, Dr. A. J. G. H. Kostermans, Director, Forest Research Institute, Bogor, Indonesia, Mr. J. N. Macdonald, Minister for External Affairs, New Zealand, Professor G. E. Blackman, Department of Agriculture, Oxford University, Dr. F. C. Camargo, Director of Agricultural Research, Brazil, Mr. Jameel Ahmad, President, Idara Millia, Hydarabad, Deccan, India, Dr. F. R. Fosberg, Director, Pacific Vegetation Project, National Research Council, Washington, Sir Harold Parker, Ministry of Defence, London, Professor Kusnoto Setyodiwiryo, Director, Botanic Gardens of Indonesia, Dr. R. F. Raffauf, Smith Kline and French Laboratories, Philadelphia, Dr. P. R. Bell, University College, London, Mr. L. Y. Holliday, H. M. Ambassador to Laos, Dr. W. G. B. Garlick, Horticultural Experimental Station, Vineland, Ontario, Mr. G. B. Masefield, Department of Agriculture, Oxford University, H. E. Admiral Esparteiro, Governor of Macao and Madame Esparteiro, Mr. W. V. Harris, Director of the Colonial Termite Research Unit, Dr. F. R. Tubbs, Director of the East Malling Research Institute, Dr. K. G. Dodds, Director of the John Innes Horticultural Station, Professor J. D. Newton, University of Alberta, Canada, Professor R. Pichi-Sermolli, Florence University, Professor Winge, Carlsberg Laboratory, Copenhagen, Professor E. Knapp, Max Planck-Institute, Heidelberg University, Dr. T. H. Harrison, Director of Plant Quarantine, Australia, Professor R. Good, University of Hull, Professor Anton Brunn, University Copenhagen, Sir Godfrey Inch, Chairman of Cable and Wireless.

66. The Director accompanied Professor Pichi-Sermolli and Professor Good on visits to certain parts of Malaya to show them some of vegetation types to be found here. Among the botanists who worked for varying periods in the herbarium were:—Mr. G. H. S. Wood, Forest Botanist, British North Borneo; Dr. A. J. G. H. Kostermans, Director, Forest Research Institute, Bogor; Dr. P. R. Bell of University College, London; Professor Pichi-Sermolli of Florence; Mrs. B. E. G. Allen; and Professor H. B. Gilliland, Dr. A. Johnson, Dr. P. B. Tomlinson and Mr. I. Enoch of the University of Malaya.

XVIII. PUBLICATIONS

67. The first edition of the *Revised Flora* entitled *Orchids of Malaya* by R. E. Holttum published in 1953 was completely sold and a second edition is now being prepared and will be printed in 1957. The book on *Malayan Orchid Hybrids* by M. R. Henderson and G. H. Addison was published during the year by the Government Printer. It contains descriptions of over 200 hybrids which have been raised in Malaya or have been introduced from other countries, together with information on their cultivation. There are usually two plates of each orchid, one showing a spray and the other an individual flower. It is hoped that subsequent volumes will be produced, so that this valuable work may be kept up-to-date.

68. Volume XV of the *Gardens' Bulletin* was published on the 20th November. Owing to its length (383 pages) it was published as a full volume and not issued in Parts. It contains a long and important article on Dr. Furtado's revision of the *Genus Calamus in the Malayan Peninsula.* Almost sufficient copy is now to hand to publish a further volume of the *Gardens' Bulletin.*

69. The revenue from the sale of publications at the Gardens was $830. It should be remembered that the books written by members of the Gardens' staff, past and present, and published by the Government Printer are sold direct by the Printing Office. There is a ready demand for the small pamphlets on *Malayan Garden Plants.* Three of the existing six pamphlets are out of print, having sold some 2,000 copies each, and will be reprinted. Three new pamphlets have been prepared and it is hoped that they will be published shortly.

70. The following articles and books were published by members of the staff during the year:—

ADDISON, G. H.—New Orchid Hybrids raised and flowered Singapore. *M.A.H.A. Mag., XIII,* 3–4.

ADDISON, G. H. —Cactus and Succulents in Malaya. *M.A.H.A. Mag., XIII,* 29–31, 62–63.

ADDISON, G. H. AND HENDERSON, M. R.—*Malayan Orchid Hybrids.* Govt. Printer, Singapore.

EWART, J. W.—Indoor Plants; Climbing Aroids. *M.A.H.A. Mag., XIII,* 10–12.

FURTADO, C. X.—Palmae Malesicae, XIX—The Genus Calamus in the Malayan Peninsula. *Gardens' Bull., XV,* 32–264.

FURTADO, C. X.—"Illegitimate" Names under the Rules. *Taxon, V,* 149–153.

PURSEGLOVE, J. W.—Ridley and Rubber. *Malayan Shell, January, 1956,* 15–19.

PURSEGLOVE, J. W.—The Vegetation of the Humid Tropics with special reference to Singapore. *In press.*

PURSEGLOVE, J. W.—Plants for the Amateur, II *Mussaenda erythrophylla. In press.*

PURSEGLOVE, J. W.—History and Functions of Botanic Gardens with special reference to Singapore. *In press.*

SINCLAIR, J.—*Croton hirtus,* an Alien New to Malaya. *Gardens' Bull., XV,* 1–3.

SINCLAIR, J.—Notes on New Guinea Annonaceae, Part 1. *Gardens' Bull. XV,* 4–13.

SINCLAIR, J.—Miscellaneous Notes on Annonaceae. *Gardens' Bull., XV,* 14–17.

SINCLAIR, J.—Two New Malayan Species, *Justicia johorensis* and *Petraeovitex wolfei. Gardens' Bull., XV,* 18–21.

SINCLAIR, J.—Additions to the Flora of Singapore and New Localities in Singapore for some Plants thought to be Extinct. Part II. *Gardens' Bull. XV,* 22.

SINCLAIR, J.—A Note on *Embelia ridleyi* King and Gamble. *Gardens' Bull. XV,* 31.

APPENDIX I

STAFF OF BOTANIC GARDENS, 1956

DIVISION I–III

Appointment	*Name*	*Remarks*
Director	J. W. Purseglove, B.SC., A.I.C.T.A., F.L.S.	
Assistant Director ..	H. M. Burkill, M.A., F.L.S.	
Keeper of Herbarium ..	J. Sinclair, B.SC.	On leave from 29-2-56 to 13-10-56.
Botanist	C. X. Furtado, D.SC.	
	Chew Wee Lek, B.SC.	From 1-10-56
Curators (2)	J. W. Ewart	On leave from 25-1-56 to 10-3-56.
	G. H. Addison	
Laboratory Assistant (Special Grade) ..	J. L. Pestana	
Horticultural Assistant ..	A. G. Alphonso	Returned from U.K. (Kew) on 2-12-56.
Herbarium and Museum Assistant	Haji Mohd. Nur bin Mohd. Ghous, B.E.M.	
Laboratory Assistant ..	Bajuri bin Sappan	
Artist	Juraimi bin Samsuri	
Clerks	F. A. Pereira	
	Vincent D' Rozario	
	Miss Celine Schelkis	
Despatch Clerk ..	R. Raphael	
Stenographer ..	Miss Diana Foo	
Librarian	Mrs. L. E. Lynas, M.A.	.. From 1-10-56.
Junior Horticultural Assistant	Abdul Aziz bin Pakiri	
Junior Horticultural Assistant (Govt. House Domain) ..	Wong Siew Hang	
Storekeeper	Ismail bin Ahmad	

METEOROLOGICAL RECORDS

BOTANIC GARDENS, SINGAPORE 1956

Reading daily at 0200 hrs. G.M.T.=9.30 a.m. Local Time

GARDEN OFFICE

Month	Total rainfall in.	Highest fall in 24 hrs. in.	No. of days rainfall	Average rainfall 1914–1956 in.	Mean Max. Temp. °F	Highest Max. Temp. °F	Mean Min. Temp. °F	Lowest Min. Temp. °F	Mean Temp. dry bulb °F	Mean Temp. wet bulb °F	Mean Relative Humidity per cent
January ..	11.51	3.55	16	11.64	83.8	88.5	70.5	70.2	77.6	74.4	85.7
February ..	5.25	1.22	15	7.59	86.8	90.0	73.6	71.0	79.5	75.8	82.7
March ..	4.28	1.12	11	8.56	88.7	91.8	74.5	72.0	85.8	77.3	77.8
April	2.68	0.63	11	8.32	86.1	92.8	75.5	73.0	82.2	77.8	80.0
May	8.57	4.10	16	7.38	88.8	92.0	75.8	71.5	83.3	77.5	85.1
June	5.67	2.45	13	6.51	88.6	92.0	75.5	73.5	82.7	77.9	82.3
July	13.82	4.33	18	6.24	86.8	91.8	73.9	70.5	78.4	76.3	86.8
August ..	8.90	1.92	23	7.39	87.3	90.5	74.1	74.1	80.1	76.8	85.6
September ..	12.05	3.40	19	7.78	84.1	91.0	74.5	71.0	77.0	76.5	85.6
October ..	4.82	1.02	20	8.12	86.4	90.0	74.7	72.5	77.8	77.0	85.4
November ..	19.30	3.30	21	10.39	84.6	89.0	74.2	72.0	78.9	75.7	85.6
December ..	8.32	1.65	18	10.08	84.0	80.2	73.0	70.5	78.4	74.4	80.0
Total or Mean ..	105.17	4.33	201	100.00	86.3	92.8	74.1	70.2	80.1	76.4	83.5

METEOROLOGICAL RECORDS

BOTANIC GARDENS, SINGAPORE 1956

Reading daily at 8.00 a.m. Local Time

ORCHID ENCLOSURE FROM 21–1–56

Month	Total Rainfall in.	Highest Fall in 24 hrs. in.	No. of days Rainfall	Mean Max. Temp. °F	Highest Max. Temp. °F	Mean Min. Temp. °F	Lowest Min. Temp. °F	Mean Temp. Dry bulb °F	Mean Temp. Wet bulb °F	Mean Relative Humidity per cent	Mean Min. Grass Temp. °F	Mean Earth Temp. 4" °F	Mean Earth Temp. 1' °F	Mean Earth Temp. 4' °F	Mean Daily hrs. Sunshine hrs.	Mean Solar Radiation °F
January ..	8.48	4.00	6	83.4	89.0	71.2	69.0	71.0	72.4	96.6	69.3	78.1	80.5	82.3	..	..
February ..	4.92	1.22	17	87.1	91.0	72.6	70.0	74.4	73.7	96.4	70.1	80.2	82.4	82.3	..	..
March ..	4.29	0.96	11	88.8	91.8	73.3	71.0	75.4	74.8	96.4	72.1	81.4	83.8	83.7	6.0	..
April ..	2.66	0.63	11	87.8	91.5	74.5	72.2	76.7	76.1	97.0	71.3	82.4	84.7	84.3	5.1	..
May ..	9.52	3.79	19	85.2	91.0	74.4	71.0	77.0	76.4	96.6	72.0	80.7	83.7	84.2	3.1	..
June ..	4.61	2.00	13	85.4	89.0	74.2	72.0	76.6	76.1	94.2	72.4	80.9	82.8	83.5	4.5	..
July ..	13.73	4.00	16	84.1	89.0	73.3	71.0	75.2	74.8	97.3	71.1	79.3	81.6	82.8	4.0	136.4
August ..	8.67	1.84	24	85.7	88.8	73.3	71.0	75.6	75.1	97.6	71.6	80.3	82.3	82.5	4.4	140.5
September ..	12.20	3.00	20	85.8	89.0	73.5	71.0	76.5	75.3	94.3	71.2	80.8	83.0	82.9	4.4	139.6
October ..	5.07	1.00	21	85.2	89.0	73.7	71.5	76.5	75.8	96.2	71.1	81.1	83.1	83.7	3.7	135.4
November ..	18.12	3.53	22	83.8	88.0	73.5	71.0	75.9	75.1	96.1	67.0	80.2	81.8	83.2	2.7	131.4
December ..	7.98	1.49	22	85.9	89.5	72.3	70.0	74.4	73.5	94.7	69.9	78.9	82.0	82.4	4.0	140.9
Total or Mean	100.25	4.00	202	85.7	91.8	73.3	69.0	75.4	74.9	96.1	70.7	80.3	82.6	83.1	4.2	137.3

RAINFALL RECORDS AT THE SINGAPORE BOTANIC GARDENS

1914–56 Inches

Year	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
January	25.40	8.89	3.79	15.43	22.37	15.32	14.36	24.80	6.96	10.61	7.99	21.47	6.49	18.32	14.29
February	3.93	.43	1.08	12.83	2.07	4.74	7.23	7.73	8.21	1.71	17.16	14.12	5.70	10.97	11.94
March	9.96	5.70	11.29	11.78	2.16	9.92	7.42	8.85	7.86	7.17	10.62	9.68	3.07	16.80	8.75
April	16.60	8.96	4.43	5.48	10.74	7.32	3.68	11.85	6.35	5.11	4.35	4.83	5.11	11.83	11.87
May	4.97	3.95	6.77	5.51	8.21	8.47	5.46	9.29	10.41	7.02	7.67	10.58	5.31	9.14	3.63
June	8.58	4.57	6.14	6.58	11.69	4.33	3.62	4.46	7.29	7.27	6.10	5.92	8.39	4.58	3.70
July	4.71	9.33	10.98	2.40	5.29	8.12	8.08	5.14	3.01	10.25	7.75	2.56	11.36	3.98	7.33
August	1.14	4.77	12.69	14.73	5.77	6.62	10.86	6.79	15.16	5.93	7.12	8.71	4.76	5.37	10.74
September ..	3.14	9.55	4.80	10.67	8.88	4.82	9.30	10.41	9.41	5.58	13.60	5.83	13.26	5.65	9.80
October	4.08	7.94	5.69	9.70	6.39	10.94	9.74	13.94	7.32	2.58	8.08	14.78	7.70	7.97	7.48
November ..	7.86	10.46	11.49	5.01	6.38	7.76	9.56	11.65	13.25	9.28	5.77	12.21	9.08	9.28	17.68
December ..	9.54	11.17	7.16	9.05	9.12	8.75	7.32	5.16	8.30	8.90	4.79	11.69	10.02	11.30	10.28
Total ..	99.91	90.72	86.31	109.17	99.07	97.11	96.63	120.07	103.53	81.41	101.00	122.38	90.25	115.19	117.04

APPENDIX IV—*continued*

RAINFALL RECORDS AT THE SINGAPORE BOTANIC GARDENS—*continued*

Year	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943
January	5.22	3.89	11.60	6.67	11.50	22.46	12.12	7.07	10.10	10.25	7.44	2.97	15.07	10.92	7.45
February	8.99	4.38	4.76	6.17	6.04	7.83	5.44	1.69	6.91	8.88	5.43	7.65	6.20	3.13	12.73
March	9.06	5.71	7.72	6.43	10.07	13.25	9.57	12.82	4.57	8.80	4.45	3.87	5.25	12.57	8.34
April	2.51	14.50	7.38	5.94	5.55	5.91	4.79	6.65	9.52	7.64	7.59	8.46	7.63	14.71	9.90
May	8.67	10.52	9.07	13.72	5.16	7.69	8.34	7.60	8.16	6.65	4.54	3.32	8.12	6.63	5.67
June	8.11	12.53	8.98	7.32	7.00	4.38	8.78	3.28	3.02	8.55	5.20	14.94	1.76	5.11	6.69
July	2.15	1.89	7.08	11.70	9.85	11.68	2.73	4.62	2.61	2.14	4.29	3.49	2.58	6.43	4.08
August	7.97	1.13	6.21	1.93	7.38	12.14	3.02	4.02	4.66	6.93	15.90	11.46	5.04	8.19	5.23
September ..	9.04	7.21	10.93	8.66	7.93	3.66	3.67	1.71	7.55	8.34	9.56	4.62	2.83	6.67	10.15
October	8.23	9.01	6.89	3.60	9.80	10.52	4.62	10.37	6.76	7.03	8.66	4.72	3.82	19.57	8.92
November ..	11.61	10.82	13.26	6.78	12.08	12.89	11.87	14.84	10.62	6.25	9.73	8.66	9.12	10.82	7.89
December ..	4.49	10.08	10.86	4.47	6.70	2.52	14.47	10.27	13.36	9.20	13.78	11.89	9.54	22.01	7.57
Total ..	86.05	91.67	104.74	83.39	99.06	114.93	89.42	84.94	87.84	90.66	96.57	86.05	76.96	126.76	94.62

RAINFALL RECORDS AT THE SINGAPORE BOTANIC GARDENS—*continued*

Year	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	Average 1914–56
January	2.50	5.22	5.69	11.24	17.77	4.82	6.94	22.49	14.19	5.50	7.62	23.83	11.51	11.64
February	11.12	6.50	15.01	12.48	10.38	5.26	3.74	4.44	12.65	16.53	9.39	3.16	5.25	7.59
March	3.48	18.52	11.01	17.12	14.68	3.85	8.98	3.96	11.85	7.68	5.81	3.27	4.28	8.56
April	6.83	11.75	11.71	8.83	6.64	10.49	11.09	12.64	9.46	13.07	6.89	8.46	2.68	8.32
May	6.05	5.35	11.79	5.24	11.98	10.93	7.09	6.63	7.11	5.87	5.41	5.02	8.57	7.38
June	4.42	4.49	6.82	7.54	7.53	10.36	5.19	3.08	5.59	2.66	13.04	4.47	5.67	6.51
July	4.23	6.87	1.55	5.04	14.88	2.79	9.19	10.82	6.70	4.05	7.49	3.14	13.82	6.24
August	7.12	9.47	4.54	6.85	3.48	2.33	12.64	4.25	9.63	7.03	8.87	10.09	8.90	7.39
September	11.71	6.63	16.80	10.83	6.20	5.18	6.01	4.39	5.75	8.32	5.64	7.82	12.05	7.78
October	5.65	11.60	7.77	6.83	4.16	11.15	10.44	5.62	12.79	2.90	10.75	7.79	4.82	8.12
November	11.85	8.34	10.98	8.34	12.67	14.42	15.53	8.54	9.62	6.78	9.31	7.17	19.30	10.39
December	6.98	9.45	11.43	17.93	14.06	10.79	5.01	2.01	9.55	8.06	26.77	14.13	8.32	10.08
Total ..	81.94	104.19	120.10	118.27	124.43	92.37	101.85	88.87	114.89	88.45	116.99	98.35	105.17	100.00

APPENDIX V

INSTITUTIONS AND PRIVATE COLLECTORS FROM WHOM PLANTS AND SEEDS WERE RECEIVED IN 1956

Australia	Botanic Gardens, Adelaide; Mr. E. Pulloch, Parkes, N.S. Wales.
Austria	University Botanic Gardens, Vindobon.
Bahamas	Mrs. A. Langlois, Nassau.
Belgium	Botanic Gardens, Antwerp.
Canada	Botanic Gardens, Montreal.
Ceylon	Royal Botanic Gardens, Perideniya.
Denmark	Botanic Gardens, Copenhagen.
Finland	University Botanic Gardens, Turku.
France	Botanic Gardens, Bescancon; Ministry of Agriculture, Antibes.
Germany	Botanic Gardens of Frankfurt, Hamburg Essen, Halle, Westfalen, Kassel, Darmstadt and Jena, Mr. Robert Blossfield, Lubeck.
Gold Coast	University College, Achimota.
Hawaii	Mr. Wm. Kirch, Honolulu; Mr. J. W. Gregg, Koloa Kauai.
Holland	Botanic Gardens of Amsterdam, Utrecht and Leiden; Institute of Horticultural Plant Breeding, Wageningen.
Hong Kong	Urban Services Department.
India	Tocklai Experimental Station, Assam.
Indo-China	Mr. Holliday, British Embassy, Laos.
Italy	Universities of Modena and Padova.
Japan	Onomichi Botanic Gardens, Hiroshima; Izu Experimental Station of Medicinal Plants, Shizuoka-ken.
Malaya	Singapore Gardening Society; Department of Agriculture, Cameron Highlands; Mr. E. F. Allen, Kuala Lumpur; Forest Research Institute, Kepong; Mr. Lee Kim Hong, Singapore; Botanic Gardens, Penang; Mrs. J. B. Pickering, Singapore; Dr. Drenth, Singapore; Department of Agriculture, Kuala Lumpur; Mr. D. C. Doo, Singapore; Coronation Nursery, Singapore; University of Malaya; Mrs. E. I. Henton, Singapore; Mrs. R. Scott, Singapore; Mr. Le Doux, Johore; Dr. J. Dore, Kuala Lumpur; Mrs. C. J. E. Jarvis, Singapore; Dr. R. J. Grove-White, Singapore; Mr. Tan Siew Kuah, Singapore; Dr. Yeo Bock Choon, Johore; Palas Gardens, Cameron Highlands; Mr. M. E. L. Robey, Malacca; Mr. A. J. Braga, Singapore; Major-General Tulloch, Singapore; Dr. Wong Lai Hock, Singapore; Miss M. A. Buxton, Singapore; Mr. Quek, Singapore; Professor H. B. Gilliland, University of Malaya.
Mauritius	Botanic Gardens, Port Louis.
New Guinea	Forest Department, Lae; Mr. Elsworthy.
Poland	Panstwowy Instytut Nonkowy, Poznan.
Portugal	Coimbra University; Estacuao Agronomica Nacional, Sacavim; Jardim Museu Agricola do Ultramar; Botanic Gardens, Lisbon.
Sarawak	Forest Department, Kuching.
Seychelle Islands	Mr. C. S. Brisbane.
South Africa	University of Pretoria; Distin's Seeds, Johannesburg; Mr. L. B. Holland, Zululand; National Botanic Gardens, Kirstenbosch.
Sweden	University Botanic Gardens of Gottingen and Uppsala; Stockholm Botanic Gardens.
Thailand	Major-General Rasmee Rasnivalt, Bangkok.
Trinidad	Imperial College of Tropical Agriculture.
United Kingdom	University of St. Andrews, Scotland; London University; Royal Botanic Gardens, Kew.
U.S. of America	U.S. Plant Introduction Gardens, Florida; Mr. De Leon, Florida; Mr. Edwin Johnson, Florida; Department of Agriculture, Washington D.C.
Yugoslavia	Botanic Gardens, Zagreb.

APPENDIX VI

INSTITUTIONS AND PRIVATE COLLECTORS TO WHOM PLANTS AND SEEDS WERE SENT IN 1956

Australia	Botanic Gardens, Adelaide.
Bahamas	Mrs. V. Horan, Nassau; Mrs. A. Langlois, Nassau.
Brazil	Botanic Gardens of Rio de Janeiro and Para.
China	Botanic Gardens, Taipei, Taiwan.
Czechoslovakia ..	Botanic Gardens of Academy of Science, Kosice.
Denmark	University of Copenhagen.
Egypt	Middle East Botanic Station, El-Saft.
Fiji	Department of Forestry; Department of Agriculture.
France	The Leonina Experimental Station, Beaulien.
Germany	University Botanic Gardens, Jena.
Holland	Laboratory of Technical Botany, Delft, Mr. A. Orloff, Alsmeer.
Hungary	Botanic Gardens, Szentes.
India	Delhi University; Fruit Research Station, Saharanpur; National Botanic Gardens, Lucknow; Mr. S. Hedayetullah, Decca; Mr. Percy-Lancaster, New Delhi.
Indonesia	Botanic Gardens, Bogor.
Japan	National Kyushu Regional Agricultural Experimental Station, Kagoshima; Miyakijima Weather Station; Eisei Shikenjo, Izu Bunjo, Shizuoka-ken; Osaka Botanic Gardens.
Kenya	Graham Bell Ltd., Nairobi.
Malaya	Botanic Gardens, Penang; Department of Agriculture, Kuala Lumpur; and many private collectors.
New Guinea	Department of Fisheries, Port Moresby.
Poland	Polish Academy of Science, Crackow.
Sarawak	Forest Department, Kuching.
Seychelle Islands ..	Mr. C. S. Brisbane.
South Africa	Mr. E. H. Stein, Transvaal.
Thailand	Mr. C. Marong, Bangkok.
Trinidad	Imperial College of Agriculture.
Uganda	Department of Agriculture.
U.S. of America ..	Mr. E. Johnston, Florida; Mrs. Adams, Fairchild Tropical Gardens, Florida; Mr. Van der Laan, Florida; Mr. E. Menninger, Florida; Mr. F. W. Howe, New York; Mr. D. E. Wolf, New Jersey; Mr. Harrison Yacum, Pennsylvania.

COLONY OF SINGAPORE

ANNUAL REPORT OF THE BOTANIC GARDENS DEPARTMENT FOR 1957

BY

H. M. BURKILL
Director, Botanic Gardens
Singapore

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1958

CONTENTS

ADMINISTRATION

		Paragraph
I.	Staff	1– 6
II.	Labour	7– 8
III.	Training	9–10
IV.	Botanic Gardens Ordinance	11–12
V.	Buildings and Roads	13–16
VI.	Visitors	17–19
VII.	Band Concerts	20
VIII.	Publications	21–22
IX.	Library	23
X.	Conferences	24–25
XI.	Plant Protection Service and Agricultural Pests Supervisory Committee	26–27
XII.	Imperial War Graves Commission Cemetery, Kraji	28–31
XIII.	Nature Reserves	32–39
XIV.	Meteorological	40–41

BOTANICAL RESEARCH

XV.	Collecting and New Records	42–44
XVI.	Exchange and Acquisition	45–47
XVII.	Taxonomy	48–50
XVIII.	Loans of Herbarium material	51–52

HORTICULTURE

XIX.	General	53
XX.	Gardens maintenance	54–59
XXI.	Government House Domain	60–64
XXII.	Horticultural exchange	65–66
XXIII.	Pests and Diseases	67–70
XXIV.	Orchids	71–75
XXV.	Succulents	76

EXTENSION WORK

		Paragraph
XXVI.	Trainees - - - - -	77
XXVII.	Sales, Plants and Publications - - -	78–80
XXVIII.	Exhibitions and Shows - - - -	81–86
XXIX.	Singapore Gardening Society - - -	87
XXX.	Malayan Orchid Society - - -	88
XXXI.	Malayan Agri-Horticultural Association - -	89
XXXII.	Malayan Nature Society - - - -	90
XXXIII.	Advisory - - - - -	91

APPENDICES

		Page
I.	Staff - - - - -	21
II.	Meteorological Records (Orchid Enclosure) -	22
III.	Meteorological Records (Gardens Office) - -	23
IV.	Meteorological Records (Summary) - -	24
V.	Institutions and Private Collectors from whom plants and seeds were received in 1957 - -	24
VI.	Institutions and Private Collectors to whom plants and seeds were sent in 1957 - - -	25

MAPS

Appended—Map showing Regional Place Names mentioned in this Report.

Inside front cover — Plan of Botanic Gardens, Singapore.

Inside rear cover — (*a*) Nature Reserves of Singapore.
(*b*) Plan of Government House Domain.

ADMINISTRATION

I. STAFF

THE YEAR was an extremely difficult one as regards senior staff and subordinate technical grades. The full complement of senior staff, attained for the first time for many years in 1955 and maintained in 1956, was seriously depleted by retirement under the terms of the Retirement from the Public Service (Compensation) Ordinance, 1956, and also by having officers sent overseas to acquire higher training.

2. Mr. J. W. Ewart, Curator, was compulsorily retired after 20 years service and left the Colony on 26th March for New Zealand. Mr. J. W. Purseglove, Director, opted to retire and left the Colony on 8th March to take up the Chair of Botany at the Imperial College of Tropical Agriculture, Trinidad. He had had 21 years' colonial service. These vacancies were filled by promotion. Mr. A. G. Alphonso, who was serving as Horticultural Assistant after successful completion in 1956 of a course of training at the Royal Botanic Gardens, Kew, was promoted Curator with effect from 26th March. Mr. H. M. Burkill, Assistant Director, acted as Director with effect from 8th March and was later confirmed in the appointment from that date.

3. Of the vacancies created by these promotions, only that of Horticultural Assistant was filled, by the appointment on 1st July of Mr. Lam Hin Cheng who was then sent overseas on 24th September to the Royal Botanic Gardens, Kew, to study for the Kew Diploma. The post of Assistant Director remained unfilled either substantively or by an acting appointment for the rest of the year. Mr. Chew Wee Lek, Botanist, was sent overseas to study for a higher degree at Cambridge University under Mr. E. J. H. Corner, at one time Assistant Director of Botanic Gardens, Singapore. Mr. Chew left on 18th September. Dr. C. X. Furtado, a re-engaged pensioner was away on vacation leave and no pay leave from 8th May to 13th November. Mr. Addison, Curator, was away from Singapore on overseas leave from 30th April to 21st December. Mrs. L. E. Lynas, temporary Librarian, resigned on 30th June. The post remained vacant for the rest of the year, but candidates were interviewed near the end of the year and it is expected that a selection will be made. Mr. Sinclair, Keeper of the Herbarium, remained on duty throughout the year, but was absent from Singapore from 1st June to 6th July on an important botanical expedition in North Borneo.

4. As a result of the absences and vacancies noted above, the duties of the nine topmost posts in the Department were covered for much of the year by but three officers, and in fact there was a period of over one month when there was no substantively confirmed officer in any of them on duty in Singapore. In addition to this Mr. Burkill acted as Agricultural Officer, Singapore, from 26th June to the end of the year.

5. In the subordinate cadres of the staff, Che Kiah bin Haji Salleh, Plant Collector, retired on reaching the age limit on 31st December after 37½ years' service. Che Ngadiman bin Haji Ismail, Head Ranger (Nature Reserves), was retired from service on medical grounds after 37 years' service.

6. A new venture in the recruitment of personnel must be recorded. On 24th April Mr. Lee Siew Luan was appointed Telephone Operator to

work a 3 x 9 switchboard. Mr. Lee had been blinded in an accident some years previously and had been trained as a switchboard operator at the Gurney School for the Blind in Kuala Lumpur. He has produced his own directory in braille of the more often required telephone numbers and can take messages on a braille typewriter. The experiment is proving quite satisfactory. Mr. Lee is the first blind operator to work in Singapore. Thanks are due to the Singapore Telephone Board for converting the Department's switchboard for operation by ear and touch, and to Mrs. E. Choy of the Singapore School for the Blind for various welfare services.

II. LABOUR

7. The labour force averaged 74 men, women and juveniles at the Gardens, 4 in the Herbarium, 55 in Government House Domain and 9 in the Nature Reserves. Health on the whole was good except that the epidemic of "Asian 'Flu" in May and of 'flu again in October caused sickness and absence from work. Eight overage labourers were retired and one labourer died. Average earnings of labour for the year were: Botanic Gardens $4.43 per day, Government House Domain $4.42 per day, Nature Reserves $4.32 per day, Herbarium $3.72 per day.

8. The labourers' lines were in general kept clean and tidy but the surroundings of the Indian lines had to be constantly sprayed with dieldrin to control flies and mosquitoes.

III. TRAINING

9. As recorded in paragraph 3, a botanist and a horticultural assistant were sent overseas for further training. The botanist, Mr. Chew Wee Lek, graduated B.Sc. Hons. from the University of Malaya in 1956. He was appointed Botanist to this Department on 1st October, 1956, the beginning of the University Year, and took up a course of post-graduate studies under the direction of Mr. E. J. H. Corner, University of Cambridge lecturer in botany and at one time Assistant Director of Botanic Gardens, Singapore, and under the supervision of the Professor of Botany, University of Malaya, and of the Director of Botanic Gardens. He went to England in September to continue his studies at Cambridge University on a Government Fellowship. He is working on the taxonomic relationship of *Moraceae* and *Urticaceae*. He is expected to return to Singapore in 1959 or 1960. The Horticultural Assistant, Mr. Lam Hin Cheng, graduated from the Serdang College of Agriculture in June with the diploma of the College. He joined the Department on 1st July and was sent in September to the Royal Botanic Gardens, Kew, England to study for the Kew Certificate. He will return to Singapore in 1959.

10. Under the "Training within Industry" scheme four officers of the Department attended courses of instruction.

IV. BOTANIC GARDENS ORDINANCE

11. When the Government took over responsibility of running the Gardens from the Singapore Agri-Horticultural Society in 1878, a committee of nominated members was set up under the Raffles Societies Ordinance, No. 7 of 1878, to control the Gardens' management. It met last in 1929 and it

had even then long outlived any usefulness it may ever have had. The last set of by-laws it issued was made in 1922 [No. 8395/22] and with the demise of the committee it became impossible to bring the by-laws up-to-date or to alter them in any way. In fact such by-laws as may have remained desirable were probably unenforceable in law. No committee, no by-laws. This nice legal tangle was resolved by the repeal of the Raffles Societies Ordinance and the enactment, so far as the Botanic Gardens were concerned, of the Botanic Gardens Ordinance, No. 32 of 1957, under which the Department is administered in the same manner as any other Government Department, the management and control being vested in the Director instead of in a Committee. The Ordinance received assent on 19th September.

12. The Ordinance authorises the appointment of officers to have the powers of a police officer within the Gardens, and a set of Rules for the management and control of the Gardens has been drafted and submitted for approval by the Chief Secretary and presentation to the Legislative Assembly.

V. BUILDINGS AND ROADS

13. There has been no change in any of the office buildings except that the "lower office" window shutters and louvres were sealed for air-conditioning. This room now houses about 40 per cent of the Department's library. The Assistant Director's house was redecorated inside and out and the roof tiles renovated. The Office Ring Road and the Main Gate Road were patched, but all the roads are showing signs of wear and need attention. The P.W.D. is expected to do this work next year.

14. The above items were done by the P.W.D. The following were carried out with Gardens' resources. The pergola with concrete pillars on Lawn O collapsed early in the year and was reconstructed with tanalised timber crossbeams. The propagating house on Lawn T was repaired and pot benches replaced. Two glass houses at the Potting Yard were temporarily repaired by the Gardens' carpenter and mason. One new orchid house was built using corrugated aluminium for the roof with "Perspex" skylights; a slatted flat roofed house for hanging strap-leaved Vandas was made and repairs were done to the slatted roof and benches for the orchid species collection in the old bear pits. The airconditioned glass house put up in the garden of the Director's quarters proved to be impracticable. By day it became a sun-trap and considerably more powerful equipment would be necessary to enable control to be exercised over its internal atmosphere. The airconditioning unit was condemned as beyond repair and the whole structure dismantled. The house itself was re-erected in the orchid enclosure for the expanding collection of succulents using the glass only for the roof and the upper part of the sidewalls.

15. Excavation for a large lily pond in the quadrangle of the plant house was begun.

16. The Gardens have no satisfactory perimeter fence and in the absence of any allocation of funds to construct one, a 5-strand barbed wire fence was put up. The boundary hedge has become very ragged with age and competition from nearby trees and is full of holes made or enlarged by urchins pushing their way through. Though the barbed wire fence will not keep out anyone determined to gain improper entry, it will discourage

the non-maliciously inclined. From 1st May entrance to the Gardens by car was by the Main Gate instead of by the Office Gate. The exit remained at the Office Gate. No visitors' traffic now uses the Office Ring Road except callers at the office.

VI. VISITORS

17. A large number of official visitors came to the Gardens, amongst them being Dr. Paul Surany, Entomologist, South Pacific Commission; Dr. S. Siddiqui, Director, C.S.I.R. Pakistan; Mr. C. W. Dixon, Commonwealth Relations Office, London; Dr. J. L. Murguia, Agricultural Scientist, Uruguay; Dr. G. Julén, Plant Breeder, Sweden; Mr. B. K. Thapa, Plant Nutritionist, Nepal; Professor G. Stokey, Professor Emeritus of Plant Science of Mt. Holyoke College, U.S.A.; Lady Veronica Sackville-West, Author, and Mr. Harold Nicholson, Author, England; Dr. Robert E. Lee, Professor of Ornamental Horticulture, Cornell University, U.S.A.; Prince Lak Kashemsanta, Department of Agriculture, Thailand; Dr. L. v. Olah, Professor of Genetics, Treub Laboratory, Indonesia; Lord and Lady Perth, London; Dr. G. F. Papenfuss, Phycologist, University of California, U.S.A.; Dr. R. F. Scagel, Phycologist, University of British Columbia, Canada; Dr. M. Doty, University of Hawaii; Dr. P. Bell, London University.

18. Many visiting research workers were afforded facilities for working in the Herbarium: Dr. E. F. Brunig and Mr. J. A. R. Anderson both of the Forest Department, Kuching, (forest trees); Mr. P. S. Ashton, Forest Department, Brunei (Dipterocarpaceae); Dr. A. A. Bitancourt, Instituto Biologica, Sa Paulo, Brazil (coffee diseases); Dr. R. E. Holttum (ferns, orchids); Mrs. B. E. Allen (ferns); Mr. T. C. Whitmore (Dipterocarpaceae) on a Commonwealth Welfare and Development Fund Fellowship; Professor H. B. Gilliland, University of Malaya (local flora); Dr. Bryce Douglas and Dr. Kiang Ai Kim of the University of Malaya (Phytochemical Survey); Mr. I. Enoch, University of Malaya (Aglaia); Dr. (Mrs.) A. Johnson, University of Malaya (Bryophytes).

19. As usual the Gardens were frequented by very many casual visitors, both local residents and from elsewhere. The arrival of luxury cruise liners was always marked by a tremendous influx of foreign visitors for whom traffic arrangements were made to permit a flow of taxis. It is a pity that many visitors with a genuine and active interest, either professional or amateur, in horticulture arrive unheralded without any appointment at the Gardens' Office. Visitors coming from overseas must usually know well ahead the expected date of their arrival in Singapore and a letter stating their interest and wish to call would be appreciated.

VII. BAND CONCERTS

20. Concerts were given on 14 occasions during the year by bands of the following regiments: 1 Rhodesian African Rifles, 50 Gurkha Field Engineer Regiment, 2 Royal Welch Fusiliers, 1 King's Own Scottish Borderers, 1 King's Dragoon Guards, 1 South Wales Borderers, 2/10 Gurkha Rifles, 1 Royal Lincolnshire Regiment, 1 Loyals, and 1/2 Gurkha Rifles. The Commanding Officers of these regiments and the General Officer Commanding Singapore Base District are thanked for their courtesy in permitting their bands to play. On Federation of Malaya Independence Day, 31st August, the Gardens were kept open till 10 p.m. and the band of the Far East Air

Force, R.A.F., gave an evening concert. The Commander in Chief, Far East Air Force, and the Director of Music are thanked for their kindness in sending their band from Changi for this special occasion. Whenever a band plays in the Gardens the number of visitors is always immensely increased. There is no doubt that these performances are greatly appreciated by the public.

VIII. PUBLICATIONS

21. An issue of the Gardens' Bulletin was prepared during the year and will be published early in 1958. The second edition of *Orchids of Malaya* by R. E. Holttum was published. Both this and *Malayan Orchid Hybrids* by M. R. Henderson and G. H. Addison are having a ready sale to the public not only in Malaya but in many countries of the world.

22. The following articles were published by members of the staff during the year:—

ADDISON, G. H.: Longevity in Orchid Flowers, *Malayan Orchid Review* 5 (1).

ALPHONSO, A. G.: Cultivation of Ferns, I, *Malayan Agri-Horticultural Association Magazine* 14 (1).

ALPHOSO, A. G.: Cultivation of Ferns, II, ibid 14 (3).

BURKILL, H. M.: Malayan Rubber, *Malayan Nature Journal* 12 (1).

PURSEGLOVE, J. W.: A bulbul's nest, a strange occurrence, *Malayan Nature Journal* 11 (3).

PURSEGLOVE, J. W.: Plants for the Amateur, II, *Mussaenda erythrophylla*, Malayan Agri-Horticultural Association Magazine 14 (1).

PURSEGLOVE, J. W.: History and Functions of Botanic Gardens with special reference to Singapore. *Tropical Agriculture* 34 (3).

IX. LIBRARY

23. The main part of the library continued to be housed in the building intended for the spirit collection, much of which has had to be boxed and is not conveniently available. The lack of proper and adequate accommodation is a serious handicap. Though the construction of a suitable building featured in the Development Programme for 1957, no allocation of funds was made available for it. By doubling up the senior staff into office space in the main office building, the lower office was cleared, fitted with airconditioners and iron racks were put in. These now hold the library overflow not housed in the spirit collection room. Previously these books had been kept on the upper floor of the herbarium where they were constantly exposed to damp and infestation of book vermin. Twenty-five books were added to the library, but the main source of accession remains exchange with other institutions. Reciprocal exchange operates with 186 organisations.

X. CONFERENCES

24. The Ninth Pacific Science Congress was held at the Chulalongkorn University, Bangkok from the 18th to the 30th November by invitation of the Government of Thailand to mark the year 2,500 of the Buddhist Era. It was extremely well organised, and was well attended by scientists from all the major countries of the world including all the countries of South-east Asia. Mr. H. M. Burkill went as a Singapore Government delegate, and in the Botanical Section was convenor of one symposium "Problems confronting

tropical botanical institutions" in which papers by Mr. Purseglove (" A brief history of Botanic Gardens with special reference to Singapore") and himself ("Some current problems of the Botanic Gardens, Singapore") were presented. Mr. Burkill also attended the section on Conservation in which he read another paper ("A Survey of Nature Conservation on Singapore Island.").

25. No representative of the Singapore Government was able to attend the meeting of the Plant Protection Committee held at Kandy, Ceylon, in December, and the interests of this Government were cared for by the representatives of the Government of the Federation of Malaya. Nor was there any representative from this Department at the Third Pan-Indian Ocean Science Congress held in Madagscar in September.

XI. PLANT PROTECTION SERVICE AND AGRICULTURAL PESTS SUPERVISORY COMMITTEE

26. The Borneo Territories turned down a regional scheme for a plant protection service and plans on a pan-Malayan basis were agreed between the Governments of Singapore and the Federation of Malaya. Singapore will meet 27 per cent of the cost and the Federation 73 per cent. The Service will be based on Singapore and the staff will be on the establishment of this Department. Recruitment of a locally-domiciled honours graduate in agriculture or botany proved impossible owing to the lack of suitable candidates. Arrangement in principle has however been made that a selected person will be attached to the Australian Plant Quarantine Service for one year to undergo training. In the meantime requests have been made under international aid agreements for an "expert" to initiate the service.

27. Mr. Purseglove served on the Agricultural Pests Supervisory Committee established under the Agricultural Pests Ordinance, No. 37 of 1952, up to 7th March. Mr. Burkill served from 7th June and was Chairman from 26th June.

XII. IMPERIAL WAR GRAVES COMMISSION CEMETERY, KRANJI

28. Work was concentrated during January and February in turfing as much as possible of the grounds with a fine-leaved *Zoysia* sp., giving a dense but springy mat, in preparation for the official opening ceremony in March. The permanent staff of 1 caretaker and 13 gardeners was augmented by 24 extra labourers and by the end of February one third of the grounds had been so turfed, the rest remaining under *Axonopus compressus*.

29. His Excellency the Governor, Sir, Robert Black, K.C.M.G., O.B.E., declared the Cemetery and War Memorial officially opened on 2nd March. The ceremony was attended by a large crowd of people from Singapore, Malaya, the Commonwealth and late allied and enemy countries. The Botanic Gardens supplied extra pot plants for the occasion. During the year over 29,000 visitors are estimated to have come to the Cemetery. In March there were 15,020 visitors.

30. The work of returfing with *Zoysia* was continued for the rest of the year. It is a small but noteworthy disability of this strain of *Zoysia* that it carries a considerable quantity of dead herbage below its topmost growth

and in close cutting this is exposed leaving a lawn brown in patches. Recovery is quick as new growth soon covers it up. (See also para. 70). Over 2,500 flowering shrubs were planted, most of them for decoration in the headstones border.

31. Though the Botanic Gardens are responsible for supervision of the cemetery, the horticultural policy is decided by the Imperial War Graves Commission whose horticultural officers, stationed at New Delhi, India, pay frequent visits. Funds for the upkeep of the cemetery are provided by the Commission in whose reports more detail may be found.

XIII. NATURE RESERVES

32. The Board of Trustees consisted of:—

Nominated by the Governor-in-Council	1. Mr. E. Galistan. 2. Inche Yusof bin Ishak.
Nominated by the Minister for Local Government, Lands and Housing	3. Mr. M. W. F. Tweedie, Director, Raffles Museum (to 11th July). Mr. Tan Hoon Siang (from 17th September). 4. Professor H. B. Gilliland, Professor of Botany, University of Malaya (on leave of absence, 2nd June to 12th September). Dr. D. S. Johnson, Department of Zoology, University of Malaya (*vice* Prof. Gilliland, 2nd June to 12th September).
Nominated by the City Council	5. Mrs. Amy Ede (to 7th December).
Nominated by the Rural Board	6. Mr. A. L. B. Swaine.
Chairman (*ex-officio*)	7. Director of Botanic Gardens— Mr. J. W. Purseglove (to 7th March). Mr. H. M. Burkill (from 8th March).

33. Mr. Tweedie and Mr. Purseglove left the Board of Trustees on retirement from Government Service. Mr. Tweedie had served the Board since its first constitution on 29th June, 1951. The periods of nomination to the Board of Mrs. Ede and Mr. Swaine expired during the year, and both were reappointed. Mrs. Ede later ceased to be a Trustee on expiry of her term of office as a City Councillor on 8th December. Mr. Swaine is the only present trustee who has served since its inception.

34. The trustees held six meetings during the year.

35. The Legislative Assembly resolved on 4th December that the Pandan Reserve be reduced from 1,373 to 370 acres,* though the reduction was strongly opposed by the Board.

36. A fibre-glass dinghy and an outboard engine were bought for use in the Pandan Reserve, but the employment of labour (see Annual Report 1956) was held in abeyance, pending a decision on the reduction of the reserve.

37. Work in the other reserves has gone on normally, much attention being given to Bukit Timah. Three direction posts were erected on the public high-way indicating the main entrance to the reserve. The look-out points

* Since increased to 542 acres.

have all been renovated. Notice boards advising that the area is a nature reserve were put up; also maps in "Perspex" fronted holders. Both the notice boards and holders suffered damage by hooligans, and one map was stolen. As the Board works on a tight budget, continuous and extensive damage cannot be made good so that irresponsibility and selfishness of a few may have repercussions on the pleasure of the many welcome visitors who respect the spirit of the reserves.

38. The three rangers and nine labourers on the Board's pay-roll were at work throughout the year. The Head Ranger was on medical (T.B.) leave from 1956 to the end of this year when he was retired from service by medical board. The labourers' quarters at Bukit Timah were completely renovated by the Public Works Department.

39. Quarrying at Bukit Timah is a constant source of alarm and during the year there were two instances of quarry encroachment as a result of which lengths of the reserve boundary path were blasted away. The recommendations of the Select Committee on Granite Resources and Nature Reserves on Singapore Island (Command White Paper No. 6 of 1951, Colony of Singapore) regarding Lot 67/31, lying within the Bukit Timah Reserve on which stands the Bukit Timah Bungalow, were that on expiry of the lease it should be incorporated within the Reserve. The lease was terminated on 31st December, 1954, and the Board applied for possession (see paragraph 67 of the Annual Report for 1955). In 1957 the land was allocated to the Telecommunications Department on condition that the public would be given access to what is one of the finest viewpoints on the Island.

XIV. METEOROLOGICAL

40. Observations were continued at the meteorological stations at the office and in the orchid enclosure. Records are tabulated in the Appendix. The rainfall in 1957 (78.50 inches) was the lowest, except in 1941 (76.96 inches) for any year since 1914 when reliable records were first taken.

41. The pattern of rainfall in Singapore appears quite unpredictable and any month may be the wettest or the driest for the year. Rainfall in January, for instance, was 2.50 inches in 1944 which was the driest month of the year and was the driest January for the period 1914–57, but in 1951 it was the wettest for the year and the period with 22.49 inches. The only certainty is that no month is ever completely dry.

BOTANICAL RESEARCH

XV. COLLECTING AND NEW RECORDS

42. With an increase in the vote for plant collecting, it was possible to increase the number and range of expeditions. Not counting the many single day forays into the Singapore Nature Reserves and countryside and into Southern Johore, the following expeditions were made:—

J. W. Purseglove and Md. Shah bin Haji Md. Nur	Bako National Park, Sarawak	2–18/2	136 nos.
H. M. Burkill	Pulau Satumu (Raffles Light), Singapore	30/1–3/2	17 nos.
H. M. Burkill	Pulau Senang, Singapore	2–6/8	10 nos.
H. M. Burkill	Malacca	19–20/4	20 nos.
H. M. Burkill	Fraser's Hill, Pahang	30/4–4/5	56 nos.
H. M. Burkill	Kanburi, Thailand	25–27/11	64 nos.
J. Sinclair and Kadim bin Tassim	Mt. Kinabalu, Ranau and Sepilok Forest, Sandakan, North Borneo	1/6–6/7	416 nos.
J. Sinclair	Malacca	20–21/4	14 nos.
J. Sinclair	Mersing, Johore	4–5/12	6 nos.
Chew Wee Lek and Kiah bin Haji Salleh	Trengganu, Kelantan	27/3–11/4	32 nos.
Chew Wee Lek	Pulau Langkawi and Perlis	10–25/5	14 nos.
Md. Shah bin Haji Md. Nur	Fish Culture Research Station, Malacca	5–10/5	60 nos.
Md. Shah bin Haji Md. Nur	Nilai, Negri Sembilan	17–24/9	82 nos.

This opportunity is taken to acknowledge the help given Departmental officers on these collecting trips. Thanks are due to Dr. E. F. W. Brunig, Forest Department. Sarawak, and Mr. T. Harrisson, Sarawak Museum, Mr. G. Seidenfaden, Danish Ambassador to Thailand, Nai Tem Smitinand of the Royal Thai Forest Department, Mr. G. L. Carson, Mr. D. J. Nicholson and Mr. F. V. Webster of the North Borneo Forest Department, Mr. K. H. Bryant, State Forest Officer, Kelantan and Trengganu, Mr. J. Wyatt-Smith, State Forest Officer, Kedah and Perlis, Dr. G. Prowse of the Fish Culture Research Station, Malacca, and Mr. D. R. Maw, Manager, Jindaram Estate, Nilai.

43. A considerable amount of valuable and interesting material was collected during these trips. Mr. Purseglove accompanied by Professor Gilliland, Professor of Botany, University of Malaya, completed a preliminary botanical survey of the new National Park situated at the mouth of the Kuching River. Mr. Burkill continued his observations on algae at Raffles Light and neighbouring islands, collected algae at Malacca and, since he was on casual leave and travelling without collecting equipment, his numbers at Fraser's Hill were mostly Bryophytes which presented no technical complications of preservation. The collecting trip in Thailand was made during an interlude in the Ninth Pacific Science Congress in Bangkok in a locality 30-50 kilometers north of Kanburi (Kanchanaburi) in the foot hills of the Menam-Meklong watershed. Mr. Sinclair's visit to North Borneo was primarily to study *Myristicaceae* but a very rewarding general collection was made. An account of this trip will appear elsewhere. His collecting at Malacca and Mersing was done on casual leave. Mr. Chew Wee Lek collected *Moraceae*

and made pickled specimens for his studies at Cambridge University. 'Che Md. Shah's collecting has been one of sampling the vanishing vegetation. At the new Fish Culture Research Station pond site, flora was collected prior to initial flooding, and at Nilai the primary forest, being felled for rubber planting, was collected over. In this he found two hitherto undescribed species of *Annonaceae*. This is a rather soul-searing form of botanical study but with the extensive acreages of primary jungle being felled in Malaya it is considered desirable to know what was there even if it may now no longer exist. The Department is extending this aspect of collecting and a programme of work at areas of forest felling in Malaya will be carried out in 1958.

44. As already indicated new records were found during this work. In the relatively little known flora of Sarawak and North Borneo, novelties and species poorly represented in herbaria were collected. New records for Malacca are *Rotala indica, Drymaria cordata, Lindernia sessiliflora* and *Rotala leptopetala* var. *pentamera* which is also new to Malaya. New for Johore are *Scirpus squarrosus, Polygala paniculata, Litsea sebifera* (planted two miles north of Simpang Rengam on the main trunk road), *Halophila spinulosa,* a marine Angiosperm found in the Johore Straits. New to Singapore are *Dipterocarpus kunstleri* and *D. sublamellatus*. Another new record will serve to show how the amateur may add to scientific knowledge. A British serviceman on patrol against terrorists in a tin mining area near Siputeh in Perak collected a plant of *Oldenlandia* which cannot be matched in the Herbarium. It is undoubtedly a new record for Malaya, if it is not a new species.

XVI. EXCHANGE AND ACQUISITION

45. 9,438 duplicates were distributed to other botanical institutions in 1957. This is by far the greatest number ever sent out except in 1947, when some 10,733 sheets were dispatched. The present number consisted both of specimens collected during 1957 and older specimens accumulated over the years. Some unnamed pre-war specimens have now been determined and will be distributed next year. Storage space is limited, and it will ease the congestion if more of these can be distributed.

46. 2,544 duplicates were received in exchange from outside institutions during the year. This was less than last year when the number was 6,768, but in the long run a fair balance is struck. These acquisitions are gratefully acknowledged. Although everyone cannot be mentioned by name the following were among the principal contributors:—Herbarium Bogoriense; Royal Botanic Garden, Edinburgh; Forest Departments of Lae, Sarawak and North Borneo; British Museum; Rijksherbarium, Leiden; the Forest Research Institute, Kepong and the University Andalas at Pajakumbuh, Sumatra. In addition, some 53 sheets were received from Vientiane collected by Mr. L. G. Holliday, His Excellency the British Ambassador to Laos.

47. As a result of domestic collections by officers of the Department and from exchange duplicates received and mounted, 6,016 sheets were laid-in in the herbarium. Eight new cabinets were bought, four for palms and four of the general size.

XVII. TAXONOMY

48. Mr. Sinclair completed his revision of the Malayan *Myristicaceae* (Nutmeg family) and the text was submitted for printing in volume 16 of the *Gardens' Bulletin*. This Bulletin has several papers of significant interest and will be published early in 1958. Mr. Sinclair continued his studies on the *Myristicaceae* by extending the field to the whole Malaysian region for a

revision for the Flora Malesiana. This work may take another four years. The first genus to be tackled was *Gymnacranthera,* but the lack of staff to share routine duties delayed progress. Some time was spent on the other genera in this family, especially annotating the sheets sent on loan and in separating the difficult and critical sheets from the simpler ones which are no longer required for study. As some of the herbaria wish their specimens to be returned quickly, it was thus necessary to spend time on a preliminary sorting out of the sheets available for only a limited time, and to examine them first. Some sheets, however, will have to be retained so that they can be compared with yet other sheets, mostly types or isotypes, from Florence, Paris and Kew which are not at hand at present.

49. Mr. Chew Wee Lek began preliminary investigation into the *Moraceae* (Fig family) which he will continue at Cambridge while working for a higher degree.

50. Routine herbarium work continued with drying, poisoning and mounting new specimens, repairing damaged sheets of old specimens, and identification of collections. Most of the material collected by officers of the Department during the year was determined, or, if it could be identified here, was sent to experts elsewhere. Acknowledgement is made of the help these persons have given. A very large quantity of unnamed specimens has been received from North Borneo, Sarawak, New Guinea and other countries for determination but little progress has been possible with the depleted botanical staff and those on duty diverted to administrative routine. A welcome development has been an increased interest shown by schools, teachers and pupils sending specimens for naming, some crushed and battered beyond recognition but the intention is good and it is hoped the Education Department will do all in its power to foster this interest. The more people there are with an active and intelligent appreciation of the flora (and fauna), the greater the need for effective nature conservation on a permanent basis.

XVIII. LOANS OF HERBARIUM MATERIAL

51. 4,174 sheets were sent on loan for study as against 4,525 in 1956. The majority went to Leiden and the principal families asked for were *Connaraceae, Cyperaceae, Lycopodiaceae* and *Rhizophoraceæ.* These are for Flora Malesiana revisions.

52. A total of 3,182 sheets of *Myristicaceae* (Nutmeg family) from 19 different herbaria was sent on loan to the Keeper of the Herbarium in connection with his study on that family for "Flora Malesiana". Each sheet is being examined and labelled with the correct name as far as possible, or if there is difficulty, a provisional name is given. The Directors of those herbaria sending material here are thanked for their kind co-operation. In many cases their material has helped to solve difficult problems. These loans are not however entirely one sided for our own interest, as the lending institution benefits by receiving back their material correctly named according to current taxonomic ideas.

BUKIT TIMAH NATURE RESERVE

The only remaining block of primary lowland forest in Singapore Island. This hill of 163 acres, to 581 ft. altitude, has been a botanical collecting ground since 1820. It is the *locus classicus* for the first studies on Malayan botany and is the type locality for many species, some endemic.

PANDAN NATURE RESERVE

A river scene on the Sungei Jurong at half tide. Left and right edges, bushes of *Rhizophora conjugata;* left edge background, trees of *Casuarina equisitifolia;* vegetation opposite, mostly *R. conjugata* admixed with *R. mucronata, Avicennia* spp., *Bruguiera* spp., *Ceriops tagal, Sonneratia* spp., *Xylocarpus granatum, Lumnitzera* spp., *Scyphiphora hydrophylluceа, Aegiceras corniculatum,* etc. This is a type locality for certain marine animals.

HORTICULTURE

XIX. GENERAL

53. It is with regret that the death is recorded of Mr. Lim Hong Hee at the age of 63 years on 1st November. Mr. Lim started his career as a transmission clerk of Messrs. Cable and Wireless. He lost this employment during the worldwide slump in the early 1930's, and set up on his own as a nurseryman. His business, The Gem Nurseries, developed into a progressive concern through pioneering, perseverance and perspicacity. Mr. Lim was amongst the early horticulturists to introduce foreign orchid stock and to raise his own material. He was certainly the first local nurseryman to send orchid blooms overseas by air. Commercial nursery gardening in Singapore owes much to him.

XX. GARDENS MAINTENANCE

54. All the lawns were maintained in good condition. With two extra Hayter motors in use it was possible to keep the remotest parts of the Gardens including the Arboretum and Lawn Z well cut. The Gardens have about 40 acres of grass and use the following mechanical equipment to cut it on weekly rotations:—Dennis 24 inch cut—3, Aveling—Barford "Atom" motor scythe —1, Hayter rotor scythe 24 inch cut Villiers 4 stroke engine—2.

55. Routine planting was carried out in the beds. Some 120 plants were put out as individual plantings. Eighteen new beds and borders mostly on Lawn O were made. Over 500 plant labels were made or repainted. There continues to occur in the Gardens the time-old trouble of misplaced and mixed labels. The culprits undoubtedly are Primates, but by no means are they confined to the resident longtailed macaque monkeys (*Macaca irus*). Liberal application of Sterameal, cow dung and artificials such as Sulphate of Ammonia, N.P.K. mixture and rock phosphate were given to all beds. Also considerable quantities of compost were made from lawn sweepings and plant debris.

56. When the wall was built around the southern end of the lake in 1956 the water was drained away and many of the aquatic plants were killed. In anticipation of completion of the wall around the northern end no replanting was done. It now seems certain the wall will not be completed at all in the near future.

57. A huge *Ficus retusa* tree was blown down in the northern end of the lake smothering a part of the rockery of aroid and marantaceous plants. As much of the tree was in the lake itself its recovery without causing damage to the rockery was a difficult task. Altogether 11 trees died or had to be cut down. Two *Casuarina sumatrana* and a willow (*Salix* sp.) sapling were planted near the lake.

58. The bamboo collection on Lawn W was checked and labelled.

59. The quantity of fish in the lake is a constant source of amazement. True the public feeds them with great amounts of bread but this can only be a small fraction of their total diet. This is a good object lesson of the potential fruitfulness of fresh water ponds as a source of food. The Lake contains golden carp, catfish and *Tilapia*. There are also possibly as many as six Malayan Mud Turtles (*Trionyx cartilagineus*).

PANDAN NATURE RESERVE

In a main channel—near the sea.

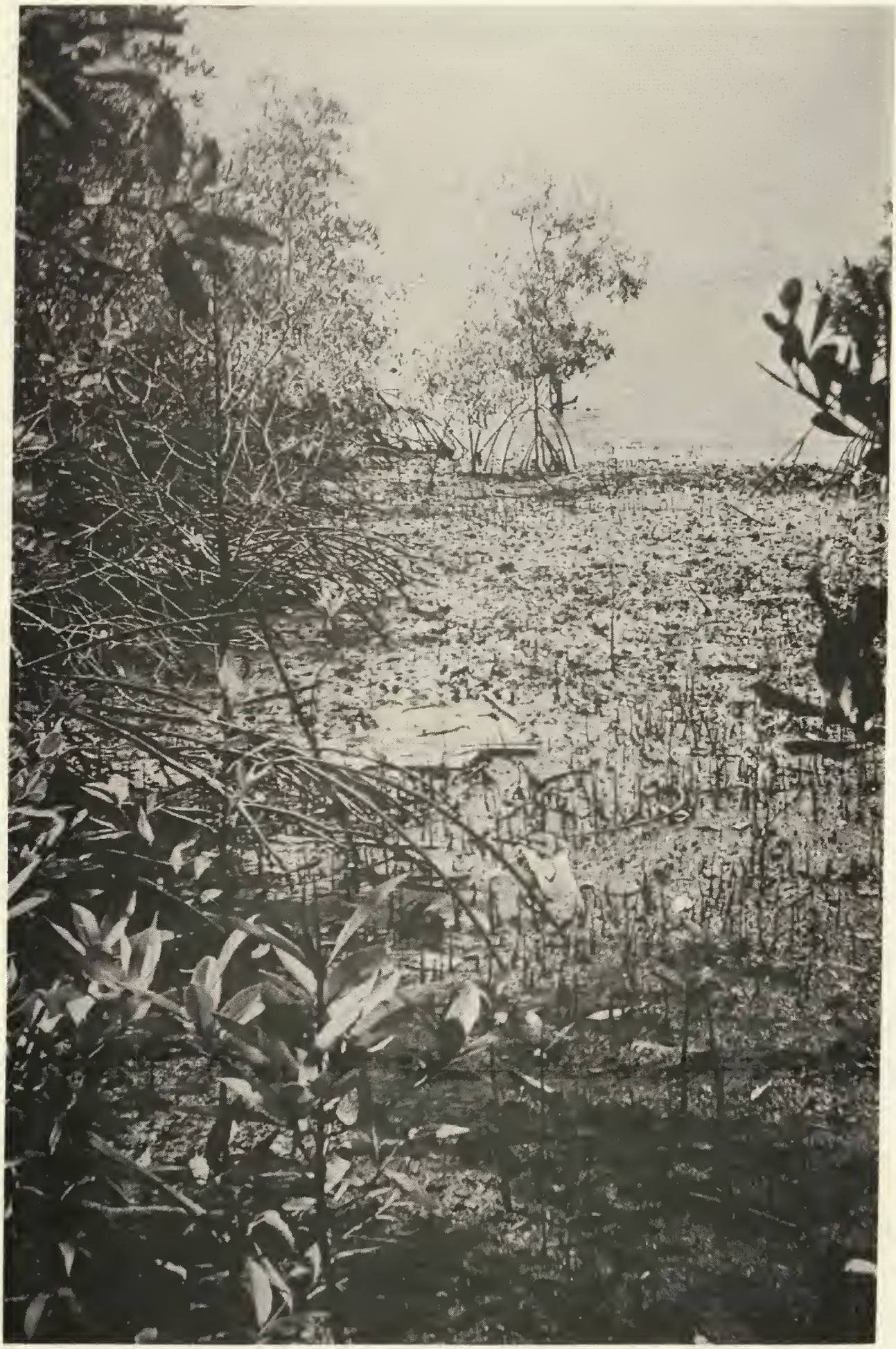
Avicennia alba

Scyphiphora hydrophyllacea

other vegetation mainly *Rhizophora conjugata*

On the Tanjong Penjuru Road—inland.

Regenerating mangrove of larger stature than on the coastal fringe. Earth lumps on roadside thrown up by a burrowing prawn (*Thalassina* sp.) in making ventilation chimneys.



PANDAN NATURE RESERVE

Foreshore vegetation near low tide. Stilted plants of *Rhizophora conjugata,* seedlings in foreground of *R. mucronata,* and air-roots of *Avicennia* in the exposed mud.

BOTANIC GARDENS' LAKE

Mussaenda philippica var. *Dona aurora*

An extremely showy variety of a Phillipine species in cultivation in the Botanic Gardens. The enlarged sepals are creamy white and up to 3–4 inches long.

XXI. GOVERNMENT HOUSE DOMAIN

60. The grounds were maintained in good condition throughout the year. A Hayter motor scythe proved very useful in trimming roadside verges and small areas unworkable by normal mowers. The Ransome Gazelle has been found excellent for mowing slopes and banks, some of them quite steep. The additional mechanical equipment brought into use released labour for work on the outlying parts of the Domain. The area on the north-east side hitherto not cuttable by machine was graded and many small self-sown saplings were removed.

61. During the year all young trees and shrubs which had been recently planted were manured. The *Stenolobium stans* in front of Government House received special attention and amply repaid the extra care by flowering six to seven times. This particular plant responds extremely well to heavy manuring, both in growth and in freedom of flowering. *Bougainvilleas* which are also a feature of the Domain around the house require much less manuring with the exception of *B. poultoni* which responds as well as does *Stenolobium stans*. All the Canna beds at Government House, Chief Secretary's House, Under Secretary's House and Attorney-General's House as well as the beds in the nursery were replanted once during the year. The hedges, particularly those near the IN & OUT Roads and the *Baphia* hedge near the second gate were heavily manured, the latter twice. Compost heaps were maintained, the general gang spending two or three days per month making them. There were complaints from the Health Department about fly breeding, but these were eventually kept under control by using "Agrocide." The chief reason why flies breed in the compost heaps is that poultry by their constant scratching prevent the compost heaps from heating correctly. Spent hops were collected weekly from the breweries and cattle manure when available from the quarantine station. Large quantities of elephant dung were obtained for the first time; it was found good as an activator in composting. Burnt soil was made monthly.

62. The beds of orchids in the nursery were extended. Amongst the varieties grown, the chief type is Arachnis Maggie Oei; there are also a number of beds of Vanda Miss Joaquim, Vanda Amy and various Arandas. A number of orchid beds were planted in the potting yard enclosure so that there might be better control over cutting blooms. The potting yard benches were changed in a number of cases to chengal (*Balanocarpus heimii*), replacing the kapor (*Dryobalanops*) which rots quickly.

63. The gardens in front of Government House, at the Chief Secretary's House, the Attorney-General's House, the Under Secretary's House and the new garden were kept cut and tidy with no major alteration taking place. Five large Bougainvilleas were replaced with *Congea velutina.* The *Mucuna* on the pergolas in front of the house deteriorated and two new ones were planted as possible replacements if and when the old one dies. *Mucuna bennettii* does not seem to like short mown turf around its roots; it was much better before the rockery beds around it were levelled and laid down to grass.

64. The kitchen garden produced salad vegetables, bayam (*Amaranthus*), long beans (*Vigna sinensis*), brinjals (*Solanum melongena*), artichokes (*Helianthus tuberosus*) and lady's fingers (*Hibiscus esculentus*). There has been some difficulty in getting watercress to grow well in this site; trials are being made at the potting yard enclosure but it is not known yet whether these will be successful. Beds of Canna, Gerbera, Gladiolus, Artemesia and various other herbaceous plants were maintained for use as cut flowers.

XXII. HORTICULTURAL EXCHANGE

65. Seed and plant exchange with botanical, horticultural and pharmaceutical institutions throughout the world was maintained. 514 packets of seeds and 273 plants or planting materials were received, and 473 packets of seed and 198 plants or planting materials sent out. Lists of donating and receiving addresses are given in Appendices V and VI. One of the most commonly requested items for exchange is palm seed. The Gardens has one of the largest collections of palms extant, but our efforts to fulfill requests for seed have been seriously frustrated by the depredations of monkeys, who failing to obtain adequate food from the public, for whose delectation alone they are allowed to remain, or from the forest trees in Gardens' jungle, have recently taken to plucking the unripe palm seed as a source of food. (See also para. 67).

66. Amongst the newly introduced plants now established, a variegated form of *Ficus elastica* and a beautiful *Gloriosa rothschildiana* are most noteworthy.

XXIII. PESTS AND DISEASES

67. There is only one serious pest and that is the vast number of monkeys inhabiting the Gardens and Tyersall Park. There are other pests, it is true, but measures to deal with them can be taken without affront to public opinion. Thus the monkeys are not merely a pest, but also a problem of public relations. One attempt to dispose usefully of those who would let themselves be caught brought swift reaction from a number of sentimental persons with nothing better to do than to be difficult. On another occasion a hired trapper was involved in a brawl with a stalwart citizen of Singapore who was prepared to come to the monkey's aid with fisticuffs. Thirty-five years ago the monkey population was estimated to be about 100. Now there are about 300 divided into three main troops. They were certainly reduced in numbers during the war years 1942–45, but their present rate of increase must surely match that of Singapore's own population. Little enough damage is done on a Saturday afternoon and on a Sunday when the whole population hangs around the most frequented parts of the Gardens awaiting feeding. Their week-end gorging lasts them for a couple of days longer and then a bleak mid-week period begins. Occasionally there may be forest trees in fruit in the Gardens but more often there is inadequate natural food available and in their quest for substitute food extensive horticultural damage is done. Twelve monkeys were shot during the year and six caught, but considerably stronger measures will have to be taken to limit their numbers.

68. Damage to the palm collection by the Rhinoceros beetle (*Oryctes rhinoceros*) continues. The damage is shown by the perforations of the leaves and petioles. Palms affected were *Phoenix, Licuala, Oreodoxa* and especially *Corypha*. Some measure of control was obtained by inserting para-dichlorbenzine crystals into the holes and plugging them with mud. Preventive measures by collecting the grubs from their nursery sites are the best. On one occasion over 1,000 grubs were collected. More serious damage has been done by the Red Stripe weevil (*Rhynchophorus ferruginea* var. *schach*). Two *Sabal palmetto* and three *Phoenix rupicola* have been killed and several trees disfigured. The larvae of this pest attack the growing point of the palm cabbage, and eventually the fronds fall off leaving a bare trunk. Control was attempted by spraying with Agrocide and Dieldrin but no satisfactory solution has been found as the symptoms of attack are revealed too late to save the plant.

69. A large quantity of larvae of the Rhinoceros beetle were supplied to the Entomological Section of the South Pacific Commission to assist in a biological control project on this serious pest in the South Pacific area.

70. During the year difficulty was experienced at the Kranji War Cemetery with a fungus attacking the *Zoysia* turf causing brown patches and rings. The pathogen was identified by Mr. A. Thompson of the University of Malaya as *Helminthosporium oryzae,* a weak parasite of grasses causing "Leaf spot" of rice. It is not a serious disease but its appearance is most prevalent during prolonged wet weather when lawns become covered with unsightly brown areas of infestation. A number of fungicides have been tried to control the fungus but with partial success only. If a satisfactory control can be obtained and a convenient method of husbandry worked out to avoid brown patches on mowing, this grass should find extensive use for growing especially high quality turf. It is not yet known whether the grass will stand up to much treading, and it would be premature to try it on a large scale in areas liable to wear.

XXIV. ORCHIDS

71. The half of the enclosure inside the security fence now given over to orchid cultivation will have to be extended into the other half displacing the plant introduction nursery to elsewhere, probably to a site to be prepared on Lawn X. Fourteen new beds were made for planting out half-grown new orchid hybrids. All orchid beds received heavy mulching, most of them being mulched and replanted 2–3 times during the year.

72. Many plants were received on an exchange basis. The firms or individuals concerned were Mr. Boey Cheng Heng, Mr. A. J. Braga and Coronation Nursery, Nam Kee Nursery, Seng Heng Nursery and T.M.A. Orchids Ltd. Dr. Womersley of the New Guinea Forest Department supplied some interesting species and seed. Seed was also received from various individuals for sowing and raising on the basis of a proportionate return of the seedlings to the donor. Amongst interesting plants to be introduced were Vanda Kono, V. Afterglow, V. Ernest Fuginaga, Dend. Lady Hamilton and Dend. Waikiki Beauty, but the most outstanding plant obtained was Vandanthe Tomas Felipe Camache from Seng Heng Nursery.

73. With staff shortage, less hand-pollination was done. Fifty-four crosses were made, of which 20 set seed. These were sown in addition to the 50 pods presented to the Gardens by local people, as well as pods from New Guinea, Australia, New Zealand, Barbados and America. The number of orchid hybrids which flowered for the first time was 21, 11 of which not previously named appear at the beginning of the list which follows: *1093:* *Arachnis hookeriana* var. *luteola* × *Renanthera monachica* (Aranthera Dainty); *1451:* Dendrobium Constance × Dend. champagne (yellow); *1597:* Dend. Lim Chong Min × Dend. Mauna Kea; *1319: Arachnis flosaeris* × Vandanthe Ellen Noa; *977:* Arachnis Ishbel × Vandanthe Ellen Noa; *1472:* Aranda Gold Star × Vandanthe Ellen Noa; *984:* Arachnis Maggie Oei × *Trichoglottis fasciata; 1226:* Vanda Gilbert Triboulet × Aranda Catherine; *920:* V. Kapoho × V. Gilbert Triboulet; *1256: Arachnis hookeriana* × Vanda Saphir; *909: Vanda luzonica* × V. Gilbert Triboulet; *1000: Arachnis hookeriana* × *Vanda caerulea* (Queen of Purples); *1472:* D. Colin Potter × *D. phalaenopsis; 1501:* Neo-Hawaii × *D. phalaenopsis* var. *hololeucum* (D. Lelia Camp); *1281:* D. Champagne × D. Constance; *2104:* D. Sarie Marijs × *D. hololeucum* (D. Marissa), *1742: D. undulatum* × *D. alba* (D. Pauline); *1840:* Vanda Josephine van Brero × Vandanthe tatzeri (Vandanthe

Howell Mundell); D. Ursula × *D. phalaenopsis* (D. Ellen Harris); *1059:* Arachnis Maggie Oei × *V. tricolor* v. *sauvis* (Aranda Bertha Braga). Of the foregoing the following are worthy of special mention: 984, a good shaped flower borne on sprays of 1½–2 ft. long. Up to 10 flowers are out together, each flower being yellow with dark brown or brown-red transverse bars, but it is not free flowering in Singapore; 1093 Aranthera Dainty, 10–15 flowers are borne on inflorescences 1½–2 ft. long. The flower colour is delicate pink-red with spots and bars of a darker hue. Seedlings flower when only 10 inches high; 1472, as in all *Vanda spathulata* progeny this closely follows the female parent. The most noteworthy point of this hybrid is that it is an Aranda cross which at the best of times is unusual. The flowers are small round and flat with leaves almost copper coloured; 1840 Vandanthe Howell Mundell, raised from seed obtained from Mr. H. S. Tan, very similar to V. Tan Chay Yan but not quite as good a shape.

74. In the laboratory, experiments in the use of coconut milk in orchid media, initiated late in 1956 continued during the year. The agar was impregnated with 13 different treatments:—

(1) Vacin's culture prescription and 100 per cent young coconut milk.
(2) Vacin's culture prescription and 100 per cent mature coconut milk.
(3) Vacin's culture prescription and 50 per cent young coconut milk.
(4) Vacin's culture prescription and 50 per cent mature coconut milk.
(5) Vacin's culture prescription and 25 per cent young coconut milk.
(6) Vacin's culture prescription and 25 per cent mature coconut milk.
(7) Vacin's culture prescription and 100 per cent young coconut milk and fish emulsion.
(8) Vacin's culture prescription and 100 per cent mature coconut milk and fish emulsion.
(9) Agar-Agar and 100 per cent young coconut milk.
(10) Agar-Agar and 100 per cent mature coconut milk.
(11) Vacin's culture prescription and fish emulsion.
(12) Agar-Agar and fish emulsion.
(13) Vacin's culture prescription (control).

Treatments are not replicated for statistical interpretation but from observation treatment 5 gives promising results with the largest and healthiest seedlings. Treatment 13 appears next. Treatments 7, 8, 9 and 10 had bad results.

75. For many years it has been noticed that some flasks sown and treated in the usual way produced spherical deformed plants of a morbid appearance. Under microscopical examination the tissue was seen to be a proliferating mass of undifferentiated cells suggestive of a carcinoma. One flask, containing such seedlings was sent to a cancer research hospital in New York, but the flask failed to stand the journey. Professor Gilliland of the University of Malaya has examined them and confirms our own opinion that the plants affected can grow out of this condition. It is possible that sowing too thickly may be a cause but it is curious that when it occurs it will be found in all the flasks containing seed of the same cross and sowing.

XXV. SUCCULENTS

76. Little addition was made to the range of the succulent collection. The most interesting one was *Epiphyllum ackersmannii,* a close relative of the well-known "Kheng-fa", *E. hookeri,* Haw. It has a deep red flower which opens during the day instead of at night as does Kheng-fa.

EXTENSION WORK

XXVI. TRAINEES

77. The Gardens offer facilities for training a limited number of persons as Gardeners. During the year trainees were accepted from the Public Works Department—4, The Rehabilitation Section of the Labour Department—4, and one from the Shell Oil Coy, Seria, Borneo. They came to the Gardens for 4–6 months.

XXVII. SALES

78. A total of 25,611 plants, bulbs and cuttings were sold to the public, 4,852 were orchid plants and 385 succulents. This is a smaller total than in the three previous years but because of the increasing demand for and sale of orchid plants commanding much higher prices than other plants, the revenue from plant sales was the greatest yet recorded. The sales for the past five years are summarised in the table below:—

Year	Sales						Total	
	Garden Plants		Orchids		Succulents			
	No.	$	*No.*	$	*No.*	$	*No.*	$
1953	12,330	6,456	2,787	11,072	..	..	15,117	17,528
1954	24,057	7,496	2,740	11,920	..	..	26,797	19,416
1955	24,224	5,302	2,730	16,005	874	880	27,828	22,187
1956	25,666	4,008	3,446	22,759	426	478	29,538	27,245
1957	20,374	3,795	4,852	28,209	385	284	25,611	32,288

It is clear from the trend shown in this table how quickly the popularity of orchids is increasing. During the year a large number of unflowered orchid seedlings were released for sale, and the orchid enclosure in the Gardens witnessed scenes reminiscent of the bargain clearance sales of the big emporia in the town, but acted by a predominately male cast. Here-to-fore orchid sales had been conducted from 3–4 p.m. on Mondays to Fridays, but the progressive increase in time taken by a technical officer of the Department in attending to this matter called for some urgent rearrangement. Many of the persons coming ostensibly to buy orchid plants or cuttings took the opportunity of wandering around looking at the flowers, wasting the officer's time. Some took the opportunity of filching near ripe hand-pollinated seedpods and a number of pods were lost in this manner. 3–4 p.m. became stretched to 2–5 p.m. Therefore from September sales in the enclosures ceased. Planting material as it becomes available is now taken to the potting shed for sale from 8 a.m.–2 p.m. on Mondays and is sold along with other planting material.

79. The Gardens continued to supply planting material free of charge to Singapore Government Departments, charitable institutions, the University of Malaya and the Services. The P.W.D. took the biggest requisition for planting in new school compounds and at official quarters. Over 8,000 plants and cuttings were supplied to these different organisations.

80. The sale of Gardens' Bulletins, Reports, Gardens Guide Book and Malayan Garden Plants series totalled $404.80.

XXVIII. EXHIBITIONS AND SHOWS

81. The Gardens participated in several shows during the year of which two were in the international class. A large consignment of orchid blooms and some aroids were sent to the Royal Horticultural Society's Annual Show held at Chelsea London in May. The staging of our display was arranged by Mr. Purseglove, who was on leave in England prior to retirement. Thanks for assistance are also due to Dr. R. E. Holttum and to Mr. L. Stenning, Curator, Royal Botanic Gardens, Kew. Though individual blooms were put up for awards, none was successful. The display as a whole however was awarded the Banksian Silver-gilt Medal for Gardens, Flowers and Ornamental Plants. Another larger consignment of orchids was sent to Hawaii for the Second World Orchid Congress in September. No award was won though blooms were entered for competition in four classes of cut flowers: Vandas, Dendrobiums, Other Genera and Collections. It must be noted that the Malayan Orchid Society was strongly represented at the Congress. Mr. Tan Chee Tong won awards for the best cut-flower Vanda and the best cut-flower Dendrobium in the show. These were Dend. Caesar (white) and V. Tan Chay Yan var. Ong Siew Hong, a dark brown sibling of this family.

82. The Gardens staged a non-competitive display at the Malayan Agri-Horticultural Association show in Kuala Lumpur in July. Three groups of plants, orchids, succulents and Saintpaulias were shown. Acknowledgement is due to the Ministry of Commerce and Industry for financial assistance which made it possible to take part in this show. Considerable interest was shown in the Federal Capital in the Gardens' plants and many enquiries and sales orders have resulted.

83. The annual flower show of the Singapore Gardening Society was held at the Happy World Stadium on 29th–31st March. Mr. G. H. Addison was honorary show manager and Mr. A. G. Alphonso honorary assistant show manager. Two big groups of orchids and succulents were exhibited. The Government House Domain competed in various classes and were awarded a number of prizes. The Department was awarded the prize for the best hybrid raised in Singapore. The plant exhibited was Vanda B.P. Mok var. Old Rose. The pedigree of this cross is:—

Vanda dearei × *V. sumatrana*
V. sumarie

V. hookeriana × *V. teres*
V. Miss Joaquim × *V. teres*
V. Miss van Deum

× V. B.P. Mok

84. The first post-war orchid show by the Malayan Orchid Society also at the Happy World Stadium was held on 6–8th September. The Gardens gave considerable assistance in the way of pot plants and decorative material. Mr. J. L. Pestana was a member of the management committee for the show. The Gardens' exhibit of the largest group of orchids was one of the main attractions. The Department was awarded the prize for the best Malayan hybrid flowering for the first time. The plant was Aranda Mauve Star, whose pedigree is:—

Vanda luzonica × *V. caerulea*
Arachnis hookeriana var. *luteola* × V. *Flammerolle*
Aranda Mauve Star

85. In June the Gardens staged a demonstration in the Rotary Club of Singapore Hobbies Exhibition held in the Victoria Memorial Hall. The technique in its simplest requirements for growing orchids from seed was shown; also the way of collecting, preserving and mounting plants for a herbarium collection.

86. In conjunction with Messrs. QANTAS/BOAC orchids were sent for display in their stand at the Waratah Festival, Sydney, the Orchid Festival of New South Wales, Annual Show of the Victoria Orchid Club, Melbourne and the Pakistan Flower Show, Karachi. Blooms were also sent to the Commission of the Federation of Malaya in Sydney for the Federation Independence Day celebrations and to the Department of Publicity and Information, Wellington, New Zealand.

XXIX. SINGAPORE GARDENING SOCIETY

87. Several of the Society's monthly meetings were held in the Gardens and staff gave demonstrations and instruction to the members. One meeting was held in the vegetable garden attached to Government House by kind permission of His Excellency the Governor, Sir Robert Black. Mr. H. M. Burkill and Mr. A. G. Alphonso are both committee members of the Society for the current year.

XXX. MALAYAN ORCHID SOCIETY

88. The Society held two meetings in the orchid enclosure in the Gardens at which demonstrations were given by members of the staff. Mr. Addison and Mr. Pestana were members of the committee for 1957.

XXXI. MALAYAN AGRI-HORTICULTURAL ASSOCIATION

89. Members of the Gardens' staff contributed articles to the association's magazine. Mr. Purseglove was on the Committee up to 7th March and Mr. Burkill from 29th May. (See also para. 82).

XXXII. MALAYAN NATURE SOCIETY

90. The Society has an active Singapore branch which holds regular indoor and field meetings. Mr. Burkill led one field outing to the Pandan Reserve and was an 'available expert' on others. Mr. Purseglove was a committee member of the Society up to 7th March and was Chairman of the Singapore Branch up to 18th February. Mr. Burkill was a committee member of the Society from 12th July.

XXXIII. ADVISORY WORK

91. With senior staff almost entirely depleted for much of the year little outside advisory work was possible. With the exception of regular visits to Government House Domain only the most urgent needs of other official departments could be attended to. Advice and planting plans were drawn up for P.W.D. roadside tree planting at the 7 and 8 m.s. Thomson Road and on Tampenis Road near its junction with Changi Road. One hundred assorted

trees were supplied for the former and 72 *Filicium decipiens* for the latter. Visits and advice were also given to Raffles Girls' School, P.W.D. depot at Kallang, Singapore Infantry Regiment Barracks at Ulu Pandan and the Boy Scouts Camp at Jurong. Shortage of staff however did not prevent large numbers of the public, as always, calling at the office to seek advice on various horticultural subjects which was given wherever possible. Advisory correspondence was as abundant as ever. During the year 2,425 letters were received and 2,111 despatched.

APPENDIX I

STAFF OF BOTANIC GARDENS, 1957

Divisions I–III

Appointment	*Name*	*Remarks*
Director	J. W. Purseglove, B.SC. (Manc.), A.I.C.T.A., F.L.S.	Up to 7th March—retired under Malayanisation Ordinance.
	H. M. Burkill, M.A. (Cantab.), F.L.S.	From 8th March—Acting Agricultural Officer, Singapore from 26th June in addition to duties in the Botanic Gardens.
Assistant Director ..	H. M. Burkill, M.A. (Cantab.), F.L.S.	Up to 7th March.
	Vacant	From 8th March.
Keeper of the Herbarium	J. Sinclair, B.SC. (Edin.)	
Botanists	C. X. Furtado, D.SC. (Bomb.) ..	Re-engaged pensioner. On leave from 8th May to 13th November.
	Chew Wee Lek B.SC. (Malaya) ..	Sent to Cambridge University to undertake higher studies on 18th September.
Curators	J. W. Ewart	Up to 25th March—retired under Malayanisation Ordinance.
	G. H. Addison	On leave from 30th April to 21st December.
	A. G. Alphonso .. .	From 26th March.
Laboratory Assistant (Special Grade) ..	J. L. Pestana	
Librarian	Mrs. L. E. Lynas, M.A. (Cantab.)	Up to 30th June—resigned.
	Vacant	From 1st July.
Horticultural Assistant	A. G. Alphonso	Up to 25th March.
	Vacant	From 26th March to 30th June.
	Lam Hin Cheng	From 1st July. Sent to Royal Botanic Gardens, Kew, to study for the Kew Diploma on 24th September.
Herbarium and Museum Assistant ..	Haji Mohamed Nur bin Mohamed Ghous, B.E.M.	Re-engaged pensioner.
Laboratory Assistant	Bajuri bin Sappan	
Artist	Juraimi bin Samsuri	
Higher Clerical Officer	F. A. Pereira	
Clerks	V. d'Rozario	
	Miss C. W. Schelkis	Up to 13th November—transferred to Education Department.
	E. A. Scully	From 14th November—transferred from P.W.D.
Despatch Clerk ..	R. Raphael	
Stenographer ..	Miss Diana Foo Siew Lin	
Junior Horticultural Assistants ..	Wong Siew Hang	On duty in Government House Domain.
	Abdul Aziz bin Pakiri	
Storekeeper ..	Ismail bin Ahmad	

METEOROLOGICAL RECORDS

BOTANIC GARDENS, SINGAPORE 1957

Reading daily at 8 a.m. Local Time

ORCHID ENCLOSURE FROM 1–1–57

Month	Total Rainfall in.	Highest Fall in 24 hrs. in.	No. of days Rainfall	Mean Max. Temp. °F	Highest Max. Temp. °F	Mean Min. Temp. °F	Lowest Min. Temp. °F	Mean Temp. Dry bulb °F	Mean Temp. Wet bulb °F	Mean Relative Humidity per cent	Mean Min. Grass Temp. °F	Mean Earth Temp. 4" °F	Mean Earth Temp. 1' °F	Mean Earth Temp. 4' °F	Mean Daily hrs. Sunshine hrs.	Mean Solar Radiation °F
January ..	4.61	1.62	14	86.7	89.5	71.8	69.8	74.0	73.4	96.3	69.6	79.3	81.9	82.5	4.32	141.4
February ..	4.17	2.31	8	88.0	90.2	71.8	69.5	73.9	73.2	96.8	69.5	80.0	82.2	83.0	5.60	144.3
March ..	7.71	1.07	14	88.0	91.5	73.4	71.5	75.5	74.9	96.4	71.4	80.3	83.0	83.8	4.56	141.7
April ..	3.64	1.54	10	89.3	93.0	74.5	73.0	77.1	76.2	96.0	71.4	82.3	84.1	84.1	5.09	145.4
May ..	12.21	4.28	17	86.7	90.5	74.8	73.0	78.4	77.4	94.9	71.6	81.7	80.7	84.1	3.59	141.4
June ..	2.65	0.75	10	87.6	91.0	76.2	72.5	78.2	77.1	94.9	74.7	82.8	84.2	84.2	4.55	140.5
July ..	8.53	3.26	17	87.7	90.5	74.0	70.8	76.9	75.9	95.5	73.3	80.3	83.0	84.3	4.35	139.4
August ..	4.60	1.00	15	86.0	90.0	73.9	71.5	76.6	75.7	96.3	73.6	80.8	83.3	83.7	4.55	137.1
September ..	9.29	1.08	18	85.9	89.0	73.9	69.5	79.9	76.0	95.7	73.6	81.0	82.9	83.6	3.87	135.7
October ..	2.22	0.62	15	86.9	90.0	73.7	72.0	76.8	75.7	94.9	73.3	81.9	83.9	83.9	5.20	142.2
November ..	6.89	1.77	22	87.7	91.8	73.3	70.5	76.3	75.5	96.4	72.5	81.3	83.7	84.2	4.44	137.5
December ..	11.98	1.68	25	84.5	88.5	73.1	70.5	75.4	74.7	97.0	73.4	80.3	81.8	83.3	2.45	134.2
Total or Mean	78.50	20.98	185	87.1	89.6	73.7	71.2	76.6	75.5	95.9	72.3	81.0	82.9	83.7	4.38	140.1

METEOROLOGICAL RECORDS

BOTANIC GARDENS, SINGAPORE 1957

Reading daily at 0200 hrs. G.M.T.=9.30 a.m. Local Time

GARDENS OFFICE

Month	Total rainfall in.	Highest fall in 24 hrs. in.	No. of days rainfall	Average rainfall 1914–57 in.	Mean Max. Temp. °F	Highest Max. Temp. °F	Mean Min. Temp. °F	Lowest Min. Temp. °F	Mean Temp. dry bulb °F	Mean Temp. wet bulb °F	Mean Relative Humidity per cent
January ..	4.81	1.85	14	11.48	86.4	89.0	73.1	70.5	78.9	74.6	80.4
February ..	4.09	1.08	9	7.51	88.0	90.5	73.1	70.5	79.4	75.1	80.8
March ..	6.98	1.07	13	8.52	88.5	93.0	74.4	72.5	81.0	76.6	81.2
April ..	3.91	1.40	10	8.22	90.3	93.0	75.6	73.5	82.5	77.7	79.8
May	12.20	4.30	18	7.49	89.7	92.5	75.8	73.0	82.1	78.4	84.1
June	2.92	0.60	11	6.43	87.8	92.0	77.0	72.5	82.1	78.2	83.5
July	8.98	3.24	17	6.30	88.9	92.0	75.0	71.5	80.9	77.4	83.3
August ..	4.65	1.82	16	7.33	86.8	92.0	75.4	72.5	80.6	77.0	85.0
September ..	10.27	3.50	18	7.83	86.2	91.2	74.9	70.5	80.5	77.0	84.7
October ..	2.33	0.51	16	7.98	88.1	91.0	75.1	72.5	81.8	77.5	79.5
November ..	6.45	1.66	22	10.30	88.8	92.5	74.5	71.5	85.8	77.6	80.6
December ..	11.40	1.66	25	10.11	85.2	90.5	74.1	71.5	79.0	76.5	89.3
Total or Mean ..	78.99	22.69	189	99.50	87.9	91.6	74.8	71.9	81.1	77.0	82.7

APPENDIX IV

SUMMARY OF METEOROLOGICAL RECORDS, 1957

	Gardens' Office	*Orchid Enclosure*
Total Rainfall	78.99 in.	78.50 in.
Highest Fall in 24 hours	4.30 in.	4.28 in.
No. of days on which rain fell	189	185
Average rainfall 1914–57	99.86	—
Mean Maximum Temperature	87.9°F.	87.1°F.
Highest Maximum Temperature ..	93°F.	93°F.
Mean Minimum Temperature	74.8°F.	73.7°F.
Lowest Minimum Temperature	70.5°F.	69.5°F.
Mean Temperature Dry Bulb	81.1°F. at 9.30 a.m.	76.6°F. at 8 a.m.
Mean Temperature Wet Bulb	77.0°F. at 9.30 a.m.	75.5°F. at 8 a.m.
Mean Relative Humidity	82.7% at 9.30 a.m.	95.5% at 8 a.m.
Mean Minimum Grass Temperature ..	—	72.3°F.
Mean Earth Temperature 4 in.	—	81.0°F.
Mean Earth Temperature 1 ft.	—	82.9°F.
Mean Earth Temperature 4 ft.	—	83.7°F.
Mean Daily Hours Sunshine	—	4.38
Mean Solar Radiation	—	140.1°F.

APPENDIX V

INSTITUTIONS AND PRIVATE COLLECTORS FROM WHOM PLANTS AND SEEDS WERE RECEIVED IN 1957

Australia	W. B. Muir, Queensland; Botanic Gardens, Adelaide; Botanic Gardens, Canberra; J. M. Frith, Boolaroo, N.S.W.
Bahamas	Mrs. A. Langlois, Nassau.
Barbados	H. H. Bayley, St. Michael.
Belgium	A. de Clereq & Fils, Gent.
Bermuda	Department of Agriculture, Paget East.
Brazil	Institute de Botanica, Parana.
Germany	University Botanic Gardens, Westfalen; University Botanic Gardens, Wuirzburg.
Hawaii	Makiki Nursery, Honolulu.
Holland	Botanic Gardens, Utrecht.
Hongkong	Urban Services Department.
Japan	Izu Experimental Station of Medicinal Plants, Shizuoka-ken; Onomichi Botanic Gardens, Hiroshima-ken; T. Satake, Hiroshima-ken; Osaka University.
Malaya	T.M.A., Singapore; City Council Nursery, Singapore; Nam Kee Nursery, Singapore; Mr. Koh Keng Hoe, Singapore; Mr. Boey Cheng Heng, Singapore; Mr. C. O'Hara, Perak; Hon. Mr. A. J. Braga, Singapore; Mrs. T. E. Allen, Kuala Lumpur; Mrs. L. V. Meeker, Singapore; Coronation Nursery, Singapore; Department of Agriculture, Kuala Lumpur; Mrs. Tan Chee Seng, Singapore; Mr. R. Scott, Singapore; Lady Black, Singapore, Seng Heng Nursery, Singapore; Mrs. H. K. Kuok, Johore Bahru; Mr. Chay Sing Hai, Singapore; Lady Scott, Singapore; Palas Gardens, Cameron Highlands; Botanic Gardens, Penang; Sq. Leader Stevens, Singapore; Manager Vallambrosa Estate, Kluang; Mr. Tan Chye Siam, Singapore; College of Agriculture, Serdang.

APPENDIX V—*continued.*

Mauritius ..	.. Botanic Gardens; Sugar Industry Research Institute.
Mexico ..	.. Gordon Ross, Chiapas.
New Guinea	.. Forest Department, Lae; Department of Agriculture, Stock & Fisheries, Port Moresby.
New Zealand	.. H. W. Johnston, Wellington.
South Africa	.. Botanic Gardens, Durban; National Botanic Gardens, Kirstenbosch.
Trinidad ..	.. Royal Botanic Gardens, St. Clair.
Uganda ..	.. Botanic Gardens, Entebbe.
United Kingdom	.. Royal Botanic Gardens, Kew; Dr. F. R. Irvine, London.
U.S.A. ..	.. Alex Hawkes, Florida; Dr. Payne, Detroit; Edwin Johnson, Florida; Division of Plant Exploration and Introduction Bureau, Maryland; U.S. Plant Introduction Gardens, Florida; N. J. de Leon, Florida, Mr. Barry, Los Angeles.
U.S.S.R. ..	.. University Botanic Gardens, Charkoviensis; Botanic Gardens Murmansk District.
Venezuela ..	.. Dr. Leon Croizat, Caracas.

APPENDIX VI

INSTITUTIONS AND PRIVATE COLLECTORS TO WHOM PLANTS AND SEEDS WERE SENT IN 1957

Australia ..	.. Botanic Gardens, Brisbane; Botanic Gardens, Adelaide; J. M. Frith, Boolaroo, N.S.W.
Bahamas ..	.. Mrs. A. Langlois, Nassau.
Barbados ..	.. Mrs. H. H. Bayley, St. Michael.
Belgium ..	.. A. de Clereq & Fils, Gent.
Brazil ..	.. Horto Botanic Introduce, Parana.
Ceylon ..	.. Rubber Research Institute.
Cuba ..	.. G. Fowler, Havana.
Cyprus ..	.. Col. K. S. Hayes Palmer, B.F. P.O. 53.
Czechoslovakia	.. Research Institute of Fiba Plants, Temenice; Botanic Garden of Academy of Science, Kosice; Institute of Yang Natural Philosopherin Praqueq, Vysocany; David Vaclav Krasna Flora, Ultavou.
Egypt ..	.. Middle Egypt Botanic Station, El-Saft.
Fiji ..	.. Department of Forestry, Suva.
Finland ..	.. University Botanic Gardens, Turku.
Germany ..	.. University Botanic Gardens, Jena.
Gold Coast ..	.. Botany Department University College, Achimota; College of Technology, Kumasi.
Hawaii ..	.. Makiki Nursery, Honolulu.
Holland ..	.. A. Orloff Davidoff, Aalsmeer.
Hungary ..	.. Botanic Gardens, Szentes.
India ..	.. Legislative Assembly Secretariat, Calcutta; Indian Agricultural Research Institute, New Delhi; Mysore Government Gardens, Bangalore; Fruit Research Station, Saharanpur; National Botanic Gardens, Lucknow; Department of Agriculture, Hyderabad; Director of Horticulture, P.W.D., New Delhi.
Japan ..	.. University Botanic Gardens, Osaka; Izu Experimental Station of Medicinal Plants, Shizuoka-ken; Miyakijima Weather Station, Tokyo; Kokuritsu Eisei Shikenjo Izu Bunjo, Shizuoka-ken; Onomichi Botanic Gardens, Hiroshima; Satake Engineering Co., Tokyo; Kyushu Regional Agricultural Experimental Station, Kagoshima Prefecture.

APPENDIX VI—*continued.*

Jamaica	A. E. T. Vermont, Labyrinth P.O.
Kenya	Manager, Graham Bell Ltd., Nairobi.
Malaya	Department of Agriculture, Kuala Lumpur; Botanic Gardens, Penang, Forest Research Institute, Kepong and many private collectors.
Mexico	Senor Carlos Pricto, Mexico City; Gordon Ross, Chiapas.
New Guinea ..	Department of Agriculture, Port Moresby; Department of Forestry, Lae.
New Zealand ..	Fruit Research Station, Auckland; Botany Division Christchurch; Department of Agriculture, Cook Island.
Nigeria	Agricultural Department, Ilorin.
Samoa	Department of Agriculture, Apia.
Sarawak	Forest Department, Kuching; Survey Department, Miri.
Sicily	Giardino Allegra, Catania.
South Africa ..	E. H. Stein Transvaal; The University Pretoria.
Trinidad	Imperial College of Tropical Agriculture; Royal Botanic Gardens, St. Clare.
Uganda	Botanic Gardens, Entebbe.
United Kingdom ..	Department of Botany, Old Aberdeen; Royal Botanic Gardens, Kew; Royal Botanic Garden, Edinburgh; Botanic Gardens, Glasgow; F. W. Bartram, Nottingham; Major V. F. Howell, Surrey; C. Wright, Sheffield; D. Sanders, St. Albans, Herts.
U.S.A.	N. J. de Leon, Florida; Arnold Arboretum, Massachusettes; University of Tennessee; Mr. S. Leiberman, New Jersey; Mr. H. L. Hyland, Maryland; Mr. D. W. Smith, Texas.
Venezuela	Dr. Leon Croizat, Caracas.

A MAP SHOWING REGIONAL PLACE NAMES MENTIONED IN THIS REPORT

Laos	Vientiane	...	1
Thailand	Bangkok	...	2
	Kanburi	...	3
Malaya	Perlis ...	...	4
	Pulau Langkawi	...	5
	Kelantan	...	6
	Trengganu	...	7
	Siputeh	...	8
	Frasers Hill	...	9
	Nilai ...	...	10
	Malacca	...	11
	Simpang Rengam	...	12
	Mersing	...	13
	Pulau Satumu & P. Senang	...	14
North Borneo	Mount Kinabalu	...	15
	Ranau ...	...	16
	Sandakan	...	17
Sarawak	Bako National Park		18
Sumatra	Pajakumbuh	...	19

STATE OF SINGAPORE

ANNUAL REPORT OF THE BOTANIC GARDENS DEPARTMENT FOR 1958

BY

H. M. BURKILL

Director, Botanic Gardens
Singapore

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1960

CONTENTS

ADMINISTRATION

		Paragraph
I.	Staff	1– 7
II.	Labour	8
III.	Training	9– 10
IV.	Botanic Gardens Ordinance	11
V.	Buildings and Roads	12– 15
VI.	Visitors	16– 18
VII.	Band Concerts	19
VIII.	Publications	20– 22
IX.	Library	23– 24
X.	Conferences	25– 27
XI.	Plant Protection Service and Agricultural Pests Supervisory Committee	28– 29
XII.	Imperial War Graves Commission Cemetery, Kranji	30– 31
XIII.	Nature Reserves	32– 38
XIV.	Meteorological	39– 40
XV.	Financial Provision	41

BOTANICAL RESEARCH

XVI.	Collecting and New Records	42– 50
XVII.	Exchange and Acquisition	51– 52
XVIII.	Taxonomy	53– 57
XIX.	Loans of Herbarium Material	58– 59

HORTICULTURE

XX.	Gardens Maintenance	60– 68
XXI.	Pests and Diseases	69– 70
XXII.	Government House Domain	71– 78
XXIII.	Orchids	79– 87
XXIV.	Succulents	88

EXTENSION WORK

XXV.	Trainees	89
XXVI.	Sales	90– 92
XXVII.	Exhibitions and Shows	93– 98
XXVIII.	Singapore Gardening Society	99
XXIX.	Malayan Orchid Society	100
XXX.	Malayan Nature Society	101
XXXI.	Malayan Agri-Horticultural Society	102
XXXII.	Advisory Work	103–105

ADMINISTRATION

I. STAFF

THE EXTREMELY difficult staff position recorded for 1957 remained little relieved in 1958 and shortages still threw an undue burden on available personnel and greatly limited the activity of the Department.

2. It is with regret that the deaths are recorded of two faithful long service members of the Department during 1958. Haji Mohamed Nur bin Mohamed Ghous, B.E.M., re-engaged pensioner, Herbarium and Museum Assistant, died on the 8th November at the age of 60 years. He had served the Department since 1st January, 1913 and for his outstanding ability and faithful service was awarded the British Empire Medal in 1955. 'Che Ngadiman bin Haji Ismail, pensioner, lately Head Ranger, Nature Reserves, died at the age of 54 years on 24th September, eight months after his retirement. He has served the Department since 1st January, 1921.

3. The post of Assistant Director was vacant throughout the year. Local and overseas advertisement produced no response. The post of Librarian, vacant January to March, was filled on 1st April by the appointment of Mr. Tan Kim Ho. The post of Herbarium and Museum Assistant fell vacant on 8th November on the death of Haji Mohamed Nur bin Mohamed Ghous. 'Che Mohamed Shah acted in the vacancy for the rest of the year, and was later confirmed in the post.

4. Three officers, Botanist, Horticultural Assistant and Laboratory Assistant were absent on training awards in England, the first two for the whole year, the third for 11 months. For details see paragraph 9. Dr. Furtado, Government pensioner, lately Botanist of this Department, was retained as a training replacement officer in the post of Botanist.

5. The Director was on long delayed overseas leave from 5th April to 2nd November inclusive. During this period Mr. Addison, Curator, acted as Director.

6. The Director was Acting Agricultural Officer, Singapore, in addition to his other duties, from 1st to 10th January.

7. Of the administrative staff, the post of Higher Clerical Officer was upgraded to that of Executive Officer in the newly created Executive Service. There was no change in personnel in the office and the duties of the new post of Executive Officer, which remained vacant throughout the year, were carried out by the person holding the junior post of Higher Clerical Officer of the previous year's establishment.

II. LABOUR

8. The labour force averaged 72 men, women and juveniles at the Gardens, four in the herbarium, 55 in the Government House Domain and 9 in the Nature Reserves.

III. TRAINING

9. Under the Government's policy of training personnel, three officers were away overseas.

(i) Mr. Chew Wee Lek, Botanist, continued to study at Cambridge University, England, for a post-graduate degree, under Mr. Corner, who was Assistant Director, Botanic Gardens, Singapore, and who retired in 1946.

(ii) Mr. Lam Hin Cheng, Horticultural Assistant, continued to study at the Royal Botanic Gardens, Kew, for the Kew Diploma.

(iii) Mr. Bajuri bin Sappan, Laboratory Assistant, was sent to England on 24th January to follow a course of study on plant breeding and propagation. He studied at the John Innes Horticultural Institution, Bayfordbury, Dorset Nurseries, Poole, and the Royal Botanic Gardens, Kew.

10. Arrangements were made for Mr. Tan Kim Ho, Librarian, to go to Australia to study library management under a Colombo Aid grant given by the Australian Government.

IV. BOTANIC GARDENS ORDINANCE

11. Under section 3 (3) of the Botanic Gardens Ordinance, 1957 (No. 32 of 1957), the following officers of the Botanic Gardens were gazetted with the powers of a police officer within the Gardens [G.N. 1867 of the *Government Gazette*, Vol. 13 (78), 15th August, 1958]:

(i) Director,
(ii) Assistant Director,
(iii) Curator,
(iv) Watchmen.

By-laws were enacted under the title of the Botanic Gardens Rules, 1958, in the *Government Gazette* Supplement No. 52 of 15th August, 1958, No. S 182, See Appendix VII.

V. BUILDINGS AND ROADS

12. The Director's quarters underwent an extensive overhaul by the Public Works Department, Singapore; several timbers suffering from dry rot were replaced. This house, built in 1866, still has much of the orginal woodwork which is in excellent condition.

13. Repairs were carried out by the Public Works Department to the plant house on Lawn L. The main part of the house was enclosed with expanded metal, replacing the wire netting, to improve security. The overhead slats of the quadrangle surround were renewed and placed more widely than before to permit the trusses of *Mucuna* grown on this erection to hang through, thus being visible from below.

14. The Public Works Department also resurfaced the Upper Ring Road, Main Gate Road, a part of Liane Road and the drive to the Curator's quarters at 30 Cluny Road. Repairs were done to the road leading to the quarters of the Keeper of the Herbarium and to the Labourers' lines.

15. By Gardens' resources, the lily pond on Lawn L was completed and two plant houses at the potting yard were renovated. To accommodate the expanding quantity of orchid seedlings, another house was built in the enclosure and also a slatted-roof house for the more mature seedlings. Near the end of the year, it was decided to move all the orchid species collection from the "bear pits" near the Director's Quarters into the enclosure and work was begun to make another slatted-roof house for their concentration. The perimeter fence of the Gardens was also repaired.

VI. VISITORS

16. As usual a large number of official visitors called at the office, amongst them being Mr. E. Melville, Colonial Office; Sir Harry Jephcott, Chairman and Managing Director of Glaxo Laboratories, London; Professor

J. E. Spenser, University of California; Mr. G. Seidenfaden, Danish Ambassador to Thailand; Mrs. S. Sahni, Honorary Director Birbal Sahni Institute of Palaeobotany, Lucknow; Professor Monro Fox, F.R.S., Emeritus Professor of Zoology, London University; Dr. Salim Ali, President, Natural History Society of Bombay; and many others.

17. Many visiting research workers were afforded facilities for studying in the Herbarium and Gardens; Dr. R. E. Holttum, retired Director of this Department; Mr. D. P. Nicholson, Forest Department, North Borneo; Dr. J. S. Womersley, Department of Forest, New Guinea; Mr. E. J. H. Corner, Botany School, Cambridge; Mr. Patrick Ping Sam, Forest Ranger, Forest Department, North Borneo; Mr. J. Wyatt-Smith, Forest Research Institute, Kepong; Dr. J. L. Gressit, Entomologist, Bishop Museum, Honolulu; Professor H. B. Gilliland, Mr. I. Enoch and other lecturers and graduate and undergraduate members of the Botany Department of the University of Malaya.

18. As always the Gardens were frequented by very many casual visitors, both local residents and from elsewhere. Many arrived from far afield in the Federation by chartered bus. The Gardens figured high in the attractions offered to tourists from overseas. The arrival of pleasure cruise ships was always marked by a great influx of visitors for whom, when prior notice was given by the travel agents, special traffic arrangements were made. The lesser gregariousness of cargo ship and air travel however does not pass unnoticed and any day of the week persons obviously from other countries come to the Gardens.

VII. BAND CONCERTS

19. During the year there were 11 band performances, given by the following regimental bands: 1 King's Own Scottish Borderers; 2 King Edward's Own Gurkha Rifles; 3 Royal Australian Regiment; 2/6 Gurkha Rifles; 2/10 Gurkha Rifles. 1 King's Dragoon Guards (twice); 1 Cheshire (three times); and 1 Foresters. The Commanding Officers of these regiments and the General Officer Commanding Singapore Base District are thanked for their courtesy in permitting these bands to play.

VIII. PUBLICATIONS

20. One volume of the *Gardens' Bulletin*, Vol. 16, and Part I of Vol. 17, were published during the year.

21. The preparation of Supplement I to *Malayan Orchid Hybrids* was far advanced during the year.

22. The following articles by members of the staff were published during the year:

Anonymous (G. H. Addison): Descriptions of New Malayan Hybrids. *Mal. Orchid Rev.* 5 (2), 5 (3), 1958.

Burkill, H. M.: A Report on R.R.I.M. Large-scale variety Trials of HEVEA BRASILIENSIS Muell-Arg. on Malayan Estates, 1934–1953. I. *Res. Arch. Rubb. Res. Inst. Malaya* Doc. 10 (1) 1958.

Furtado, C. X.: When was *Gymnacranthera* Warb. validly published? *Taxon* 7 (5), 1958.

Sinclair, J.: A Revision of the Malayan Myristicaceae, *Gard. Bull. Sing.* 16, 1958.

Ararocarpus—A Monstrosity. *Gard. Bull. Sing.* 17 (1), 1958.

Florae Malesianae Precursores—XX. The Genus Gymnacranthera (Myristicaceae) in Malaya. *Gard. Bull. Sing.* 17 (1) 1958.

The Flora of Cox's Bazaar, East Pakistan. *Bull. Bot. Soc. Beng.* 9 (2) 1955.

IX. LIBRARY

23. The accommodation of the library remained unchanged, the books being stored in two separate rooms neither of which was designed for this function, and both badly needed for their intended purposes. One is an office room; the other is an extension of the herbarium in which the spirit collection of plants should be stored. The lack of proper library accommodation is most unsatisfactory as it impedes the proper functioning of the library and holds up other work.

24. Library accessions included 19 books purchased, 25 periodicals on subscription, 154 copies of reprints and 268 periodicals received on reciprocal exchange from 199 institutions. This large intake of material also adds to the embarrassment of improper and inadequate library accommodation.

X. CONFERENCES

25. Mr. H. M. Burkill, Director, attended the XV International Horticultural Congress held in Nice, France, from the 11th to 18th April as Singapore Government delegate while proceeding to Europe on overseas leave. Mr. Lam Hin Cheng, Horticultural Assistant, who was at that time on a training award in the United Kingdom, also attended the Congress.

26. The Third International Seaweed Symposium was held at Galway, Eire, from 13th to 19th August and was attended by Mr. Burkill during his overseas leave.

27. The University of Malaya staged a Centenary Conference from 2nd to 10th December to mark the 100th anniversary of the work of Wallace, much of which was actually done in Malaya, and the 200th anniversary of the publication of Linnaeus's *Systema Naturæ*. Mr. H. M. Burkill, Director, and Mr. J. Sinclair, Keeper of the Herbarium, attended the conference.

XI. PLANT PROTECTION SERVICE AND AGRICULTURAL PESTS SUPERVISORY COMMITTEE

28. As reported in the last Annual Report, the regional scheme was abandoned in view of the decision of the Borneo territories not to come into such an arrangement. The alternative Pan-Malayan scheme could not be implemented as a result of the decision of the Federation of Malaya Government to organise an entirely independent service in 1958. Plant introduction arrangements for Singapore thus remain as here-to-fore.

29. Mr. Burkill, Director, was a member of the Agricultural Pests Supervisory Committee during the year, and was Chairman 1st–10th January.

XII. IMPERIAL WAR GRAVES COMMISSION CEMETERY, KRANJI

30. The Botanic Gardens continued to supervise the horticultural work of the Cemetery under instructions from the Imperial War Graves Commission Regional Headquarters in New Delhi. Funds for personnel and materials for this work were provided by the Commission in whose reports fuller detail may be found.

31. The number of visitors to the Cemetery has been estimated at about 10,600 during the year.

XIII. NATURE RESERVES

32. The Board of Trustees consisted of:

Nominated by the Governor-in-Council	1. Mr. E. Galistan	
	2. Mr. Yusof bin Ishak	1/1 to 3/2/58.
	Mr. Morgan Khoo Kay Ann ..	from 4/2/58.
Nominated by the Minister for Local Government, Lands and Housing ..	3. Mr. Tan Hoon Siang	
	4. Prof. H. B. Gilliland	
Nominated by City Council ..	5. Mr. N. Karuppiah ..	from 9/1/58.
Nominated by the Rural Board ..	6. Mr. A. L. B. Swaine	1/1 to 24/5/58.
	Mr. R. S. Boswell ..	from 25/9/58.
Chairman (*ex-officio*)	7. Mr. H. M. Burkill ..	(on leave of absence 5/4 to 2/11/58).
	Mr. G. H. Addison	5/4 to 2/11/58.

33. Mr. Swaine's retirement from Singapore, and hence from the Board, was the Board's major loss during the year. Mr. Swaine had been a trustee since the formation of the Board on 29th June, 1951 and has had a life-long interest in natural history and wild life.

34. The trustees held two meetings during the year.

35. After due consideration the Legislative Assembly amended the Schedule to the Nature Reserve Ordinance to limit the Pandan Nature Reserve to 542 acres. The land on both sides of the Jurong River estuary now remains under the Board's control.

36. Maintenance work in the other three Reserves has gone on normally, much attention being given, as previously, to Bukit Timah.

37. Three rangers and nine labourers were on the Board's pay-roll throughout the year. The Head Ranger, on medical (T.B.) leave since 1956, was invalided out of service and died a few months later. 'Che Hamzah, Ranger, was promoted Head Ranger with effect from 1st October, and the vacancy of Ranger thus created was filled.

38. The Public Works Department has applied to the Nature Reserves Board for an exchange of 2.8 acres of Quarry Reserve for 2.8 acres of Nature Reserve. This application was under consideration.

XIV. METEOROLOGICAL

39. Observations were continued at the Meteorological Stations at the office and in the orchid enclosure. Records are tabulated in Appendices II and III. Rainfall at the office was near the average for the past 44 years. At the orchid enclosure rainfall was 9 inches less and fell on 7 days fewer than at the office. Though the two sites are scarcely half a mile apart this serves to show how localised rainstorms can be.

40. Records were supplied to the Meteorological Department, the University of Malaya, including samples of rain collected for a survey of pH of rainwater, and to interested members of the public. A paint technologist was regularly given information for use in research on paints used locally. Observations on the pH of rainwater will be published in a forthcoming number of the *Gardens' Bulletin.*

XV. FINANCIAL PROVISION

41. Certain departmental projects had to be shelved as a result of the enforcement of general economy measures.

BOTANICAL RESEARCH

XVI. COLLECTING AND NEW RECORDS

42. In addition to much useful and valuable material collected and observations made in single day collecting trips into the Singapore Nature Reserves and countryside and into southern Johore, the major collecting work was carried out during the following expeditions:

J. Sinclair	Japan (while on a private visit on casual leave)	13–16/5	63 nos.
J. Sinclair	Luzon Island, P.I.	21/5–5/7	390 nos.
J. Sinclair	Selangor, Southern and Central Perak and Cameron Highlands ..	7/10–5/11	143 nos.
H. M. Burkill	Pulau Satumu and neighbouring islands	15–19/2	32 nos.
Md. Shah bin Hj. Mohd. Nur	Sabai Estate, Pahang	23/1–6/2	110 nos.
Md. Shah bin Hj. Mohd. Nur and Kadim bin Tassim ..	Trans-Perak Irrigation Scheme Area, Perak, Bota Kiri Forest Reserve	3–19/3	104 nos.
Md. Shah bin Hj. Mohd. Nur and Kadim bin Tassim ..	Bukit Paloh Estate, Johore ..	1–15/4	82 nos.

43. This opportunity is taken to acknowledge the help given in undertaking this work: thanks are due to Mr. T. Koyama of the University of Tokyo; Mr. D. R. Mendoza and Mr. G. E. Edano of the National Museum, Manila; the Master Attendant, Singapore; the Director of Drainage and Irrigation Department, Federation of Malaya, and his officers connected with the Trans-Perak Irrigation Project; Mr. G. M. Rothwell, Manager of Sabai Estate, Pahang; and Mr. W. M. Young, Manager of Bukit Paloh Estate, Johore.

44. The expeditions made by Mr. Sinclair to the Philippine Islands and into Central Malaya were chiefly to follow up his study of the Malaysian *Myristicaceæ*, but at the same time rewarding general collections were made. In the Philippines, field work was carried out at Antipolo, Province Rizal, at Mount Makiling, Province Laguna, at Sipocot, Province Camarines Sur, in the Bicol National Park botanizing as far as the province border with Province Camarines Norte; and in Province Sorsogon at Irosin, Lake Agangay and on Mount Bulusan, and also on the seashore at Bulusan. Finally a few days were spent at Baguio, Province Benguet, with two excursions up Mount Santo Tomas, one reaching the summit of 7,482 ft. altitude.

45. From this collection and from observations in the field, it is seen that the flora in the Philippines has many species in common with that of North Borneo, especially in regard to ferns, *Urticaceæ*, *Euphorbiaceæ*, *Melastomaceæ*, *Lycopodiaceæ*, *Gunnera macrophylla* and *Equisetum debile*. The mountain province of Benguet had a number of endemics (plants entirely confined to the Philippines), but there was a trace of Formosan elements too. For example, an alder, *Alnus formosana* was collected on Mount Santo Tomas. It was near a public road on the side of the steep mountain and although it is not recorded in Merrill's *Enumeration of the Philippine Flowering Plants* there is no reason to doubt its not being truly native here. The most outstanding feature of the vegetation in Baguio is the forest of Benguet Pine, *Pinus insularis*. This tree is restricted to the mountains of Luzon, Burma and Indo-China. It covers the ridges and slopes of the ranges but has been thinned out a good deal by injudicious cutting.

46. Some of the more interesting and rarer plants of Baguio were: *Lactuca dentata, Polygonum nepalense, Gynura vidaliana, Gnaphalium japonicum, Deutzia pulchra, Berchemia philippinensis* and *Lilium philippinense*. The latter is a beautiful plant with white trumpet-shaped flowers and grows in the most inaccessible places.

47. The expedition to Central Malaya yielded new records for the country. These were: *Juncus inflexus*, a rush hitherto found only on the mountains of Java but common in Europe. Two clumps were found by the roadside about a mile below the summit of Gunong Batu Brinchang, but there was only one flowering stem. It was at the summit of this mountain that the first Malayan record of a *Juncacea, Juncus prismatocarpus*, was recorded in 1956. On this mountain was also found a Himalayan grass, *Miscanthus* sp., but a specimen has been sent to Kew for checking. In the Gunong Bubu Forest Reserve, Kuala Kangsar, a tree belonging to the Mangosteen family, namely *Mammea malayana* was collected in flower. It is new to science. In the same forest male and female flowers of a much wanted species *Knema retusa* were obtained. King's collector, Kunstler once found this *Knema* in fruit in the Gunong Bubu forest. It has never been collected anywhere since and the main object of the expedition was to go back to this type locality and search for it, because its correct systematic position was not clear. Since Gunong Bubu is about 20 miles long and 5 miles wide and had a small bandit population, the chances of finding it were rather remote. It was therefore a matter of great luck to have found it and to have successfully achieved the mission.

48. Some valuable information was obtained about the flora of the Ipoh limestone which has a vegetation quite different from that of other soils. Among the plants collected on the limestone was *Mallotus petiolatus*. It was common but hitherto, in the herbarium, was represented only from a single gathering. Also two new shrubs, not yet described, were collected. The new road up to the radio station on the summit of Gunong Batu Brinchang has opened up the mountain and as a result a number of interesting plants have now been found there including new records for Malaya. Development of the country and the laying of roads to hitherto inaccessible places will facilitate more exploration and doubtless there are many novelties waiting to be found. This development however carries with it the risk of destruction of natural vegetation. Already the orchid population around the summit of Batu Brinchang is being decimated by visitors who take plants home to the heat of the lowlands where they anon die. The vegetation of such places is worthy of protection, and in particular the rare plants of the mountain forest. Many belong to the Indo-Himalayan regional flora which montane has its southern limit of distribution on the higher mountains of Malaya. This element must have been here for countless centuries undisturbed even by the ice ages of the Pleistocene and the volcanic up-heavals which broke up Malaysia into an archipelago.

49. Collections were made at Sabai Estate, Paloh Estate and in the Trans-Perak Irrigation Scheme area to sample the vanishing vegetation. This was a continuation of the work outlined in the last Report.

50. Mr. Burkill continued his observations and collections of marine algæ at Raffles Light (Pulau Satumu) and on the neighbouring islands of Senang, Biola and Pawai and on the reef Terumbu Selat Biola. Determination of these and previous collections is proving difficult in the absence of literature and of herbarium material for comparison in Singapore.

XVII. EXCHANGE AND ACQUISITION

51. 7,129 duplicates were distributed to 24 other botanical institutions of which the most important were the Royal Botanic Gardens, Kew; the Rijksherbarium, Leiden and the Arnold Arboretum, Cambridge, Massachusetts, U.S.A. (See Appendix IV.)

52. 5,877 duplicates were received in exchange from other institutions. These are gratefully acknowledged; principal contributors were the Herbarium Bogoriense, Indonesia; the Forest Departments of Sarawak, Brunei, North Borneo and the Federation of Malaya; the Rijksherbarium, Leiden and the Forest Research Institute, Dehra Dun. The Brunei specimens contained many new records since little collecting has been done in that area. The Bogor collection also provided valuable data on geographical distribution in north-east and south-east Borneo, indicating that many plants hitherto thought confined to Sarawak and North Borneo extend to the south.

XVIII. TAXONOMY

53. Mr. Sinclair's work on the Malaysian *Myristicaceæ* (Nutmeg family) has been carried on through the year. The work on the genus *Gymnacranthera* was completed and published. Examination of *Knema* was begun and a part prepared in manuscript. While in Japan (see paragraph 42) on leave, visits were made to the herbarium of the Botanical Institute, University of Tokyo; the Institute of Forest Botany, Faculty of Agriculture; the National Science Museum and the Research Institute for Natural Resources in order to examine collections of *Myristicaceæ*. Interesting material from New Guinea and the Pacific Islands was seen. While in the Philippines a few days were spent in the herbarium of the National Museum examining *Myristicaceæ* and *Annonaceæ*. Similarly two days were occupied at the Forest Research Institute, Kepong. Mr. Chew Wee Lek has continued his study of the *Moraceæ* (Fig family) at Cambridge while working for a higher degree. Dr. Furtado has spent much time checking and re-sorting material of *Mæsa, Litsea, Embelia, Grenacheria, Uncaria* and *Xanthophyllum*.

54. A great amount of material was received for naming, but with the depletion of the botanical staff and the ill-health and eventual death of Haji Mohamed Nur bin Mohamed Ghous, Herbarium Assistant, whose amazing knowledge of Malayan plants was of unique help in making preliminary determinations, this work has been delayed. The largest collection named during the year was from the Forest Department of Sarawak and Brunei. This consisted of 1,942 specimens. Almost as large numbers of specimens were named as the Department's contribution to the Phyto-Chemical Survey of the Malayan flora.

55. Mr. Burkill, while on leave in England spent some time in examining collections of Malaysian marine algæ at the British Museum, London and at the Kew Herbarium and in naming some of the Malayan collections of the Singapore Herbarium which were sent to England for this purpose.

56. Routine work of poisoning, mounting and laying-in of specimens in the herbarium and of repairing old and damaged sheets went on normally.

57. There is an immense amount of work on the regional flora waiting to be done. Ample facilities exist for visiting research workers and any who could come would be made most welcome, in particular trained botanists from the main research centres of Europe and America on which the knowledge of tropical botany still largely rests. If any could work here on an *ad hoc* problem or on general lines the gain would be mutual and to the common good.

XIX. LOANS OF HERBARIUM MATERIAL

58. A total of 2,886 sheets of specimens was sent out on loan for study during the year to eight institutions. The majority were sent to Leiden and Kew and the principal families or genera supplied were: *Ericaceæ, Eriocaulonaceæ, Thymeliaceæ, Cœlostegia, Neesia, Cyclea, Kopsia, Rauwolfia, Lygodium, Schizæa* and in the algœ, *Sargassum* and *Codium.*

59. Six institutions sent on loan 3,182 sheets of *Myristicaceæ.*

HORTICULTURE

XX. GARDENS MAINTENANCE

60. The Gardens were well maintained, and have been looking their best for many years. The lawns were kept clean and tidy.

61. A number of new beds was dug and large scale planting of herbaceous and annual plants carried out. There were over 70 new permanent plantings. 680 plant labels were made or renewed. Among the notable horticultural acquisitions from overseas which were established were *Lagerstræmia lanceolata, Eucalyptus triantha, E. microcarys, Euphorbia caracasana* var. *sanguinea,* and an interesting collection of bougainvillea hybrids, B. Lady Mary Baring, B. Mary Palmer, B. Isabel Greensmith and B. Gillian Greensmith. These latter were obtained as a result of a private visit by the Director to East Africa. The cultivation and hybridising of bougainvillea has been specially successful in Kenya where these hybrids have been raised with spectacular results. Cuttings were supplied by the courtesy of Mr. H. P. Greensmith, Superintendent, Nairobi City Parks.

62. Twenty-two plants died or were cut down, among the important ones were *Eucalyptus naudiniana, Sabal blackburniana, Petrea arborea, Lodoicea sechellarum, Albizzia ealænsis* and *Araucaria excelsa.*

63. Routine manuring, especially with compost and sterameal, was carried out on a number of permanent plants. In addition rock phosphate was used. Most of the aroids and ferns in the Plant House were fed with ammonium sulphate. As an experiment a cover crop *Indigofera endecaphylla* was grown round the base of a number of palm trees. Apart from shading the soil and the exposed adventitious roots, it allows a return to the soil in the form of compost.

64. The frangipanni collection on Lawn J was pruned and the beds manured. The canna beds along the Main Gate Road were re-newed twice during the year. Members of the cycas family which were scattered about the Gardens were duplicated and planted on Lawn D near the office as a collection. The intention is to confine this small but important genus to one area.

65. Some of the Gardens' trees were a source of danger to traffic along Cluny Road and had to be cut down or pruned.

66. Both the ginger-wort rockery and the dell rockery were repaired and replanted.

67. There was a big increase in the number of pot plants under cultivation. Late in the year 400 pots of foliage plants were prepared for the 1959 Constitution Exposition. Newly introduced crotons, roses, dahlias, anthuriums, chrysanthemums and gladioli were established.

68. Owing to the increasing demands of the orchid breeding programme, beds of newly introduced plants in the Orchid Enclosure were cleared and the material transferred to the nursery on Lawn Y.

XXI. PESTS AND DISEASES

69. The long tailed macaque monkeys in the Gardens remain the major pest. Six were shot. The services of two separate trappers, both doing big business in trapping monkeys in the Federation of Malaya for export for medical research, were enlisted, with barely any success. One caught six monkeys only, the other one. This failure is as depressing as it is interesting for these trappers catch the same species of monkey (*Macaca irus*) with conspicuous success in the forests of the Federation by exactly the same methods they tried in the Gardens. One must comment that the monkeys of the forest would seem to suffer the misfortune of a certain rustic simplicity through which they fall victim of the ruses of the ruthless trapper. And on the other hand the Gardens' monkeys raised in daily contact with their human cousins have acquired an urbanity and a protective sharpness of wit, and a familiarity and contempt for human wiles which would have done credit to many a Dickens character. There would appear to be a similar problem in the Lake Gardens of Kuala Lumpur and is one which could develop elsewhere wherever feeding by the public displaces or amplifies an inadequate source of natural food.

70. Continuous spraying of insecticides and fungicides has helped to check fungal diseases and insect pests. Certainly too the drier weather has limited epidemic conditions for fungal diseases and has thereby limited fungicide trials. The trouble with *Helminthosporium oryzæ* experienced in 1957 (see Annual Report 1957, paragraph 70) has recurred but only to a mild degree. Some damage to palms by the rhinoceros beetle (*Oryctes rhinoceros*) and the red stripe weevil *Rhynchophorus ferruginea* var. *schach*) continues. Compost heap breeding sites of the former are regularly examined and the grubs removed, but an appreciable infection must come from outside the Gardens. With the clearing of the countryside for housing projects no control is exercised over the disposal of coconut timber, which remains a source of infection.

XXII. GOVERNMENT HOUSE DOMAIN

71. The grounds were kept in good condition throughout the year. The mechanical equipment did sterling work, particularly the Hayter rotor scythe which is found to be a very versatile machine.

72. The gardens in front of Government House, the Chief Secretary's House and the Attorney-General's House were given special attention. All borders, shrubs and young trees were fed with compost and sterameal once or twice during the year or even a third time according to requirements. The shrubs of *Stenolobium stans* require liberal manuring and always repaid this extra attention. The canna beds were replanted twice and the orchid bed near the office was mulched regularly every 2–3 months. At House No. 3, occupied by the Permanent Secretary to the Ministers, the tennis court was top-dressed and brought into playing condition. Beds of shrubs and borders in the garden of this house were mulched twice. Government House and other houses in the Domain were kept supplied with flowers and flowering plants.

73. Much of the labour was concentrated on stacking and turning compost heaps. Cattle dung was obtained from the quarantine station, when available, and brewers leys for composting. A regular supply of elephant manure was obtained which is an excellent starter. Experiments were carried out using sawdust in the mixture for composting, but its decay under current methods and requirements is too slow to make it a valuable ingredient.

74. Soil for potting was burnt once a month. It is not feasable to take just any soil as the end-product varies greatly. Soil from below the overseer's quarters has proved to be the best found for sometime, though even this tends to be a little too sandy.

75. The nursery and vegetable garden were maintained, but some of the orchid beds were removed to the potting yard to keep them under closer supervision. The kitchen garden produced vegetables, particularly salad vegetables such as spring onion, parsley, mint, cucumber and lettuce. Corn (*Zea mays*), long beans (*Vigna sinensis*), Lady's fingers (*Hibiscus esculentus*), brinjals (*Solanum melongena*), spinach (*Amaranthus*), Kangkong (*Ipomœa reptans*) and sayor puteh (*Brassica chinensis*) were also grown.

76. The old machine shed behind the Guard Room was pulled down and a new one built near the potting yard. The potting shed was extended by an area of some 300 square feet and a concrete approach made to it so that lorries can be driven to its entrance.

77. The horticultural staff of the Domain competed in the 1958 Singapore Flower Show, winning two first and two third prizes.

78. Monthly visits were paid to Changi cottage and occasionally loads of compost and plants were taken for special occasions. The grass was top dressed with compost and sterameal and all the shrubs received applications of the same fertilizers.

XXIII. ORCHIDS

79. The plant house on Lawn L in which orchids used to be displayed was enclosed with expanded metal by the Public Works Department. No orchid had been on view to the public there since August 1956 when valuable material was stolen by thieves breaking through the wire netting enclosing the house. This period was as much a loss of pleasure to the public as it was an embarrassment and nuisance to the staff, who had often to deal with disappointed and sometimes testy visitors who felt aggrieved at there being nothing displayed. With the completion of expanded metal walls, orchids in prime bloom along with other choice and interesting plants have been out on display since June. Yet even though a labourer is permanently on duty in the house petty pilfering still takes place. One point will serve to indicate the problem. For long the rapid deterioration of prime orchid blooms soon after they had been placed in the display house had caused perplexity and some annoyance. Eventually it was discovered that private orchid fanciers were removing pollinia from the blooms on display for cross fertilizing their own plants. This emasculation of the flowers led to accelerated withering. Forewarned is forearmed: the labourer is now wise to this sleight of hand.

80. In the orchid enclosure expansion continued at the expense of nursery plants of the plant introduction section which is now in the process of being moved out to the nursery on Lawn Y. Old beds were re-dug, replanted and top dressed with half rotted compost; new beds were made. A problem experienced is the rate at which wooden post rot; and there is many a bed replanted not because the plants were ready for it but because their stakes had collapsed.

81. In Singapore orchid circles, foliar feeding has found great favour, and certain proprietary manures are now well established. In our own work a favourite one has been found to speed up growth initially but after prolonged application a deposit is formed on the leaves which inhibits further growth. It

is still our opinion that orchids need feeding naturally through the roots in part at least, and that probably the best results come from ringing the changes with different manures.

82. Hybridising continued as and when the desired pairs of parents could be obtained in bloom together. In all 214 pollinations were made resulting in 142 successful crosses. Acknowledgment is made of gifts of pods from Mr. H. K. Kuok of Johore Bahru; Mr. Killop of New Guinea; Mr. E. de Saram of Ceylon; Mr. M. Lewis and Mr. A. J. Braga of Singapore and Mr. W. B. Muir of Australia. Their seed and seed from our own crosses were sown in the laboratory.

83. The flask culture using coconut milk with Vacin's formula on an agar base was continued, but in the latter part of the year small quantities of banana mash were added with most encouraging results. Addition of other fruit pulps is now under investigation. The general results have been so good as to be embarrassing to the staff of the seedling houses who have been hard put to handle the enlarged number of young seedlings coming forward for potting out.

84. The following orchid hybrids which flowered in 1957 were later named in 1958:

984, Arachnoglottis Brown Bars (Arachnis Maggie Oei × *Trichoglottis fasciata*).

1472, Arandanthe Starnoa (Aranda Gold Star × Vandanthe Ellen Noa).

977, Arandanthe Chas. de Alwis (Arachnis Ishbel × Vandanthe Ellen Noa). Charles de Alwis, a Ceylon Burgher, was artist on the Gardens staff at the close of the last century and the beginning of this.

1319, Arandanthe Grandeur (*Arachnis flos-aeris* × Vandanthe Ellen Noa).

1597, Dendrobium Paleface (D. Lim Chong Min × *D. phalaenopsis* var. *Maunea Kea*).

1451, Dendrobium Concham (D. Constance × D. Champagne).

1093, Aranthera Dainty (*Arachnis hookeriana* var. *luteola* × *Renanthera monachica*).

1256, Aranda Marnie B. (*Arachnis hookeriana* × Vanda Saphir). A cross made by Mr. A. J. Braga of Singapore and raised in the Botanic Gardens.

920, Vanda Hogil (V. Kapoho × v. Gilbert Triboulet).

First flowerings in 1958 which were also named were:

2489, Spathoglottis Premier (S. Primrose var. Golden Flash × S. Dr. Yeoh).

2398, Spathoglottis Golden Fleece (S. Primrose var. Golden Flash × S. *aurea*).

857, Holttumara cochineal (Aranda Galistan var. Suntan × *Renanthera coccinea*). This is the second trigeneric hybrid to be flowered in the Gardens. Generic name is in honour of Dr. R. E. Holttum, Director, 1925–1949, who initiated this work of orchid hybridising.

1723, Dendrobium Murray Henderson (D. Neo-hawaii × D. Champagne). Named in honour of Mr. M. R. Henderson, Director 1949–1954. This hybrid has long arching sprays of peach coloured flowers.

1890, Dendrobium Harlequin (D. Tanglin × D. Taurinum). An attractive hybrid with white sepals and violet lip and petals.

2223, Vandanthe Candlelight (Vanda Cobber Cain × *Euanthe sanderiana*). A cross made by Mr. M. Lewis of Singapore and raised in the Botanic Gardens.

Our own crossing of crosses made previously elsewhere which reached flowering in 1958 were: 1716 D. Louisae; 1125 D. Helen Adams; 2031 D. Liliha; 2056 D. Anita; 1888 D. Bali, and 2001 D. Syaj. Cross 2031 was made using D. Pauline × *D. Phalænopsis* var. *schrœderianum*. There is a big variation in the siblings, but the best are free flowering with long-lasting long sprays of dark coloured flowers.

H. M. Burkill

PLANT HOUSE AND LILY POND—BOTANIC GARDENS

The central lawn is laid with a very fine strain of *Zoysia* sp. The Pergola (left) is made of trunks of tembusu (*Fagraea fragrans*), and cross-bearers for this and the raised portion are "tanalised" kempas (*Koompassia* sp.)

H. M. Burkill

FORMAL GARDEN—GOVERNMENT HOUSE DOMAIN

G. H. Addison

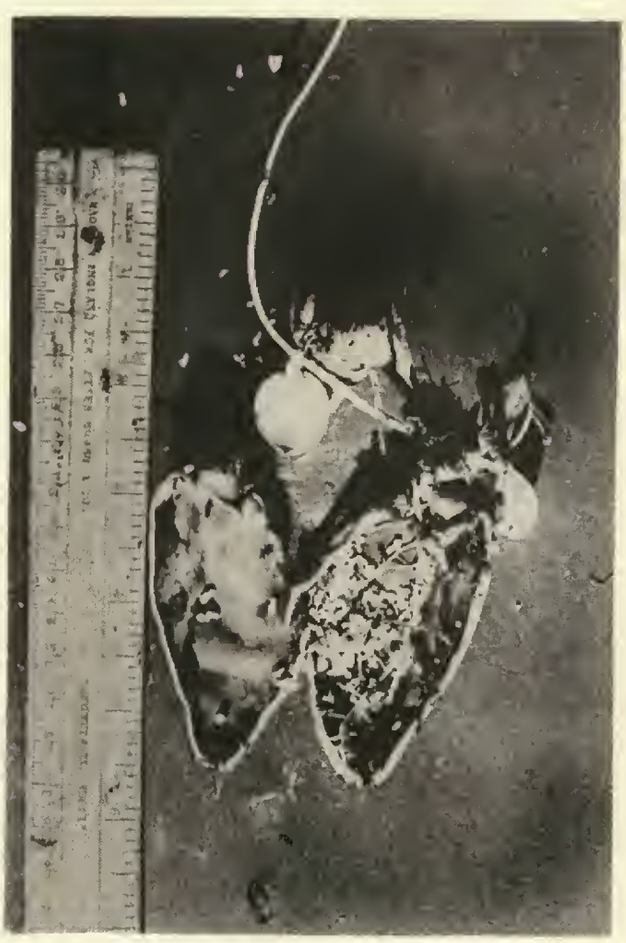
Nepenthes gracilis Korth

G. H. Addison

Nepenthes ampullaria Jack

G. H. Addison

Nepenthes rafflesiana Jack an upper pitcher



H. M. Burkill

Dischidia rafflesiana Wall.—Quite different from *Nepenthes spp.*, certain leaves are very deeply campanulate and are occupied by ants. The plant itself grows roots into the ants' nest. *Left:*—the climbing plant with normal and ant leaves. *Right:*—an ant leaf cut open showing ants, ant pupæ and plant roots

H. M. Burkill

LABRADOR NATURE RESERVE

Showing a portion of the cliff face vegetation. *Dipteris conjugata* Reinw., a montane fern in Malaya, is protected in this sea level Reserve

H. B. Gilliland

THE VANISHING VEGETATION

Primary forest in the process of being felled for estate planting. In portions of this area the dominant tree was found to be of a genus and species but newly described, *Kostermansia malayana*, Soegeng (1959). Thus does the axeman outpace the botanist

85. Other crosses as yet unnamed which flowered for the first time in 1958 were:

1475, *Dendrobium phalaenopsis* var. *compactum* × *D. phalaenopsis* var. *schroederianum.*
845, *Laelia xanthina* × *Cattleya warneri* var. *amasiana.*
1740, Dendrobium Pauline selfed.
779, *Dendrobium veratrifolium* × D. Chye Siam.
1260, *Vanda dearei* × V. Gilbert Triboulet.
2008, Dendrobium Neo-Hawaii × D. Constance.
1487, Dendrobium Caesar × Dendrobium Constance.
1420, Aranda Ishbel × *Vanda flos-aeris* var. *insignis.*
1624, Dendrobium Louisae × D. Louis Bleriot.
1400, Vanda Norbert Alphonso × Vandanthe Rothschildiana.
1525, *Vanda luzonica* × V. Kapoho.

86. In the latter part of 1958 the Malayan Orchid Society started a system of awards on much the same lines as that conducted by the Royal Horticultural Society of Great Britain. Plants raised in the Gardens which won awards were: *Award of Merit*—Cypripedium millmanii var. Twinspray, Dendrobium Gillian var. Snowflake and Aranthera Dainty var. Prolific; *Certificate of Cultural Commendation*—Aranda Mauve Star var. Blue Ribbon; *Certificate of Preliminary Commendation*—Dendrobium Murray Henderson var. Peaches, Aranda Louise Wong var. Coffee King, Holttumara cochineal var. robust. Gardens' hybrids raised outside which were awarded were: *Certificate of Cultural Commendation*—Aranda Peter Ewart, and *Certificate of Preliminary Commendation*—Renantanda storiata.

87. The Gardens are indebted to the following persons for valuable material supplies: Mr. Liau for 12 plants of *Phalænopsis serpentilingua;* Dr. Soysa for 15 plants of *Vanda tessellata;* and Mr. McKillop of New Guinea for a consignment of 70 plants of native orchids which included species of *Dendrobium, Bulbophyllum, Cypripedium, Calanthes* and *Phaius,* and a very good plant of *Grammatophyllum papuanum.* These were exchanged for orchid seedlings and cuttings of our own hybrids. Exchanges were also made during the year with Messrs. P. Liau, A. Voon, Nam Kee, A. J. Braga, T.M.A. Ltd., McKillop, N. J. de Leon, Dr. Soysa and Mrs. Kornusut.

XXIV. SUCCULENTS

88. The already large collection was expanded. In order to make room in the houses a number of specimens of the larger species such as *Alœs, Agaves* and *Cereus* was moved out into the open in November. These stood up to the rain without any apparent ill-effect. Some 150 plants were added to the display bedded out in a rockery in the plant house of Lawn L. This rockery is made of lumps of broken coral and coral chippings, and the plants quite obviously were thriving in this highly alkaline medium. Because of this, smaller species cultivated in pots were also tried with coral and 9-inch pans of 200 different species were top-dressed with coral chips. The initial success of this method of cultivation warrants its extension to the major part of our succulent collection.

EXTENSION WORK

XXV. TRAINEES

89. Three trainees were accepted from the Labour Department for instruction in gardening. They completed a course of six months. One trainee from the Shell Coy., Brunei undertook a four months course.

XXVI. SALES

90. A total of 15,780 plants, cuttings, lots of bulbs and packets of seeds were sold to the public during the year. This is appreciably less than in 1957 when the total was 20,374, but the revenue derived from it was greater, $4,241 against $3,795. The sale of orchids decreased very greatly to 2,372 plants or cuttings at $18,800 revenue from 4,852 plants or cuttings at $28,209. The causes of this are varied. To some extent the trade recession must have limited ready money for the purchase of what is undoubtedly mainly a luxury, though obviously the limitation was not so severe as to curb purchase of the relatively inexpensive planting material of ordinary garden plants. Another factor is undoubtedly the flooding of the local market with orchid seedlings from Hawaii. Though the Assembly made provision in 1956 for the import of limited quantities of orchid material from hard currency sources (i.e. in effect from Hawaii) on the satisfaction of the Director of Botanic Gardens that such plants were required for use in breeding, not one application for endorsement of foreign currency control forms was made during the year. Singapore continued to be supplied *ad lib* through the back door via Hong Kong. In the latter part of the year currency regulations were relaxed with the result that more direct importation was possible. Another factor contributing to a decrease in revenue is that the Gardens had fewer seedlings available for sale to the public.

91. The Gardens continued to supply planting material free of charge to Singapore Government departments, charitable institutions, the University of Malaya and the Services. The Public Works Department took the biggest requisition of over 9,000 plants. It is worth recording one interesting purpose to which plants supplied from this Department were put. The Singapore School for the Blind was provided with a selection of succulents—some fiercely thorny, some prickly, some downy and some smooth and fleshly. Curiosity aroused, it was explained that the plants were required for teaching touch to blind children. Spartan schooling, this!

92. The sale of departmental publications, excluding what was sold through the Government Sales Bureau, was $280.

XXVII. EXHIBITION AND SHOWS

93. The Gardens participated in several shows during the year and won awards.

94. Some 200 plants including orchids, saintpaulias, cacti, succulents and begonias were put on display at the Malayan Agri-Horticultural Association exhibition in Kuala Lumpur 26–29th June. Mr. Alphonso and Mr. Wong Siew Hang staged the display and were on duty answering numerous queries and giving advice arising from the obvious public interest.

95. At the Singapore Gardening Society's annual show held at the Happy World Stadium 28th–30th March, Mr. A. G. Alphonso was Show Manager, and Mr. Burkill was on the show committee. Mr. G. H. Addison arranged a landscape of orchids, begonias and aroids. The Botanic Gardens does not show competitively at this show except for one item: the Best Orchid Hybrid raised in Singapore. In this competition it won with a fine plant of Aranthera Dainty, a hybrid of *Arachnis hookeriana* v. *luteola* × *Renanthera monachica*.

96. The second post-war orchid show of the Malayan Orchid Society held at the Happy World Stadium 5th–7th September was a great success. Several very fine plants not previously seen in this part of the world were exhibited. The Gardens put up an impressive display of orchids and foliage plants arranged by Mr. Juraimi bin Samsuri, Artist, as a formal garden. Mr. A. G. Alphonso was Show Manager and Mr. G. H. Addison and Mr. J. L. Pestana served on the show committee. At this show the Gardens won the competition for the Best Malayan Hybrid Flowering for the first time with Aranda Louise Wong. The pedigree of this hybrid is

Arachnis flos-aeris × *Arachnis hookeriana* v. *luteola*
|
Arachnis Maggie Oei × *Vanda sumatrana*
|
Aranda Louise Wong.

97. The Gardens exhibited at the Malayan Orchid Society monthly shows and entered plants for the Society's awards. Details of successes are given in paragraph 98.

98. Orchid blooms were sent for exhibition at the *Daily Telegraph* Flower Show Festival, Harrogate, England where a Silver Medal was won; Spring Orchid Festival, Melbourne, Australia; Hastings Blossom Week, New Zealand; Asian Flower Show, Tokyo, Japan; Royal Horticultural Annual Show, Chelsea, England; North of England Horticultural Spring Show, and the Pakistan Flower Show, Karachi. Acknowledgement is due to Messrs. British Overseas Airways Corporation, Messrs. Qantas Airways and Messrs. Japan Airlines for flying these consignments without charge.

XXVIII. SINGAPORE GARDENING SOCIETY

99. Mr. H. M. Burkill and Mr. A. G. Alphonso were committee members for the year 1957/58 ending in August. The former was elected president for the year 1958/59 and the latter remained on the committee. Mr. Wong Siew Hang joined the committee for the 1958/59 year. Mr. Wong also served on the Flower Show Committee for the 1958 Show and was Assistant Show Manager. A number of the Society's meetings were held at the Botanic Gardens where demonstrations and talks on different horticultural aspects were given by the staff. One meeting on vegetable growing was held at Government House Domain by kind permission of His Excellency the Governor.

XXIX. MALAYAN ORCHID SOCIETY

100. Mr. G. H. Addison, Mr. A. G. Alphonso and Mr. J. L. Pestana served on the committee. Two meetings were held at the Botanic Gardens when talks and demonstrations were given by Mr. G. H. Addison. The Botanic Gardens orchids figured prominently at the Society's annual show (paragraph 96) and at the monthly meetings of the Society (paragraph 97). Mr. Addison was editor of the *Malayan Orchid Review* for the second half of 1958 and contributed articles and also numerous descriptions and photographs of new orchid hybrids.

XXX. MALAYAN NATURE SOCIETY

101. Mr. Burkill served on the committee of the Society from January to March and in November and December. From April to October Mr. Addison was on the Committee.

XXXI. MALAYAN AGRI-HORTICULTURAL SOCIETY

102. Mr. Burkill served on the committee of the Society from January to March and in December. Mr. Addison served from April to October. Participation by the Department in the Malayan Agri-Horticultural Society Show is referred to in paragraph 94.

XXXII. ADVISORY WORK

103. With senior staff very much depleted, advisory work was reduced of necessity by as much as possible. Little more than routine assistance to the P.W.D. and other Government departments over planting plans and the supply of plants was possible. The Department advised in many small planting schemes, at the new Government clinics at Bukit Panjang and Pegu Road, at the Chief Justice's residence, Singapore Military Forces headquarters, Teachers' Training College, Government bungalows at Teluk Paku, at Flagstaff House and at the School for the Blind. Advice was also given to the Public Works Department for planting on new road roundabouts, sidetables and centre strips. The new Bukit Timah Road dual carriageway, bypassing Bukit Timah village, was planted with royal palms in the centre, and mixed broadleaved mahogany and *Eugenia grandis* on the sidetables. The royal palms were set at 15-foot spacing in a hedgerow planting so that their trunks would eventually make a headlamp glare break. A planting plan for the new Bukit Timah-Jurong link road was prepared but this awaited action at the end of the year. Plants proposed were again royal palms in a centre strip hedgerow planting with *Adinanthera, Acacia, Filicium* and broadleaved mahogany on the sidetables and roundabouts.

104. The herbarium staff was frequently consulted by local traders seeking information on English, Malay and other coloquial names of grains, pulses and condiments, and also to confirm identity and to check purity of samples.

105. In addition a large number of visitors called at the office seeking advice on all manner of subjects including several scarcely botanical or horticultural. Enquiries were also handled by correspondence which totalled 2,049 letters in and 1,820 out. Extensive use was made of the telephone by which also came appeals to remove bees nests from houses, cats from tree tops and provision of a measured mile for a walking race.

APPENDIX I

STAFF OF BOTANIC GARDENS, 1958

Divisions I–III

Appointment	*Name*	*Remarks*
Director	H. M. Burkill, M.A. (Cantab.), F.L.S. ..	On overseas leave 5th April to 2nd November.
Assistant Director ..	*Vacant*	
Keeper of the Herbarium	J. Sinclair, B.Sc. (Edin.)	
Botanist	Chew Wee Lek, B.Sc. (Malaya) ..	On Fellowship at Cambridge University.
	C. X. Furtado, D.Sc. (Bombay) ..	Re-engaged pensioner as training replacement *vice* Chew Wee Lek.
Curators	G. H. Addison ..	Acting Director 5th April to 2nd November.
	A. G. Alphonso	
Librarian	Tan Kim Ho, B.Sc. (Malaya) ..	Appointed 1st April.
Laboratory Assistant (Special Grade) ..	J. L. Pestana	
Executive Officer ..	*Vacant*	Mr. F. A. Pereira, Higher Clerical Officer, officiating.
Horticultural Assistant	Lam Hin Cheng ...	On scholarship at Royal Botanic Gardens, Kew.
Herbarium and Museum Assistant ...	Haji Mohamed Nur bin Mohamed Ghous, B.E.M. ...	Re-engaged pensioner; died 8th November.
Vacant	Mohamed Shah bin Haji Md. Nur ...	Appointed 14th November.
Artist	Juraimi bin Samsuri	

METEOROLOGICAL RECORDS

Botanic Gardens, Singapore 1958

Reading daily at 8 a.m. Local Time

Orchid Enclosure

Month	Total Rainfall	Highest Fall in 24 hours	No. of days Rainfall	Mean Max. Temp.	Highest Max. Temp.	Mean Min. Temp.	Lowest Min. Temp.	Mean Temp. Dry Bulb	Mean Temp. Wet Bulb	Mean relative humidity	Mean Min. Grass Temp.	Mean Earth Temp. 4"	Mean Earth Temp. 1'	Mean Earth Temp. 4'	Mean Daily hours of sunshine	Mean solar Rad. Thermometer
	ins.	ins.		°F	°F	°F	°F	°F	°F	%	°F	°F	°F	°F	hours	°F
January	7.16	1.64	14	84.9	91.0	72.9	70.0	75.3	74.2	97.3	72.4	80.2	82.3	82.9	5.63	145.2
February	5.27	1.54	13	87.2	90.0	73.8	68.0	76.3	75.6	97.0	73.4	80.8	83.3	83.9	4.75	142.1
March	3.23	1.45	11	88.7	91.5	73.9	71.0	76.7	75.8	96.4	73.8	82.7	85.0	85.0	5.99	146.7
April	3.87	0.78	13	89.4	91.5	75.4	72.5	77.4	76.7	83.5	74.8	82.8	85.3	85.7	5.94	137.8
May	6.84	1.82	19	87.5	91.0	75.5	72.5	78.0	74.0	96.3	75.3	81.8	84.2	85.1	3.60	138.0
June	7.51	1.97	14	87.3	91.5	75.5	71.0	77.6	76.8	97.0	74.5	81.1	83.4	84.7	4.29	139.2
July	1.35	0.46	8	88.3	91.5	74.8	71.5	77.3	76.7	97.5	73.2	81.4	83.8	84.4	5.67	140.2
August	11.70	1.96	17	87.0	93.0	73.6	71.5	76.2	75.4	97.0	73.3	80.7	82.6	83.8	3.60	Unrecorded
September	2.51	0.71	14	87.4	90.0	74.6	72.5	77.6	76.8	96.7	74.0	81.6	84.5	84.5	5.06	
October	10.93	3.56	18	87.3	91.5	74.1	71.8	76.9	75.8	95.3	73.3	81.4	84.5	84.9	4.90	
November	21.85	5.60	20	86.5	92.0	73.5	69.0	76.2	75.3	95.7	73.1	80.0	82.5	83.4	3.71	
December	5.17	1.32	13	87.1	92.5	72.7	71.0	75.3	74.2	95.0	71.8	79.5	82.4	82.5	4.83	
Total/Mean ..	87.39	..	174	87.4	90.6	74.2	71.0	77.3	75.5	95.4	73.6	81.2	83.6	84.2	4.83	141.2

METEOROLOGICAL RECORDS

Botanic Gardens, Singapore, 1958

Reading daily at 0200 hours G.M.T. = 9.30 a.m. Local Time

Gardens Office

Month	Total rainfall	Highest fall in 24 hours	No. of days rainfall	Mean Max. Temp.	Highest Max. Temp.	Mean Min. Temp.	Lowest Min. Temp.	Mean Temp. Dry Bulb	Mean Temp. Wet Bulb	Mean Relative Humidity
	ins.	ins.		°F	°F	°F	°F	°F	°F	%
January	7.79 (11.40)*	1.61	15	85.0	91.5	73.9	70.0	80.5	76.2	81.9
February	5.68 (7.35)	1.57	15	87.8	91.0	75.3	71.0	78.0	76.8	83.5
March	3.68 (8.41)	1.54	11	87.7	92.5	75.4	72.0	82.0	77.3	80.9
April	3.45 (8.11)	0.92	14	90.8	92.8	76.2	72.5	84.0	78.6	77.8
May	7.44 (7.48)	1.84	19	89.0	93.0	76.3	73.0	81.8	76.2	85.7
June	11.90 (6.39)	2.55	15	88.7	92.5	76.3	71.0	81.8	78.3	85.4
July	2.09 (6.20)	0.83	9	90.4	93.0	76.0	71.0	82.0	78.6	85.9
August	12.81 (7.44)	2.10	19	86.6	91.0	74.3	72.0	79.3	76.8	89.1
September	3.18 (8.18)	1.35	13	88.5	91.5	76.0	73.0	83.0	78.0	82.7
October	12.73 (7.88)	1.78	19	88.0	92.0	75.4	71.8	81.2	78.0	86.7
November	21.56 (10.64)	5.24	19	86.8	91.5	74.8	71.5	80.4	77.2	84.4
December	4.32 (12.75)	1.36	13	87.2	89.5	73.8	71.5	80.4	76.2	82.2
Total/Mean ..	96.63 (97.22)	..	181	88.0	91.8	75.3	71.7	81.2	77.3	83.7

*Mean for 1914–58.

APPENDIX IV

SUMMARY OF DISTRIBUTION OF EXCHANGES AND LOANS

Distribution	EXCHANGE		LOANS	
	No. of Specimens		No. of Specimens	
	Given	Received	Out	In
1. Kew	1,365	..	624	25
2. Leiden	1,333	513	1,496	689
3. Arnold Arboretum ..	889	..	..	..
4. Bogor	349	1,945	88	..
5. Manila	286	175	..	..
6. Bangkok	618	..	..	..
7. Lae (New Guinea) ..	365	101	..	..
8. Dehra Dun	69	354	..	..
9. British Museum	173	..	..	..
10. Edinburgh	449	..	17	..
11. Berlin	196	..	..	..
12. Cambridge	197	..	..	..
13. Tokyo	20	141	530	..
14. New York	39	..	99	..
15. Lucknow	64	..	..	..
16. Sandakan	304	116	..	..
17. Sarawak	..	1,064	..	5
18. Brunei	..	1,329	..	..
19. Kepong	136	10	..	..
20. Bailey Hortorium ..	24	..	..	..
21. Munich	141	..	..	..
22. Canberra	..	..	..	259
23. Brussels	..	127	..	..
24. Florence	..	..	..	18
25. Upsala	11	..	..	..
26. Illinois (U.S.A.)	15	..	17	..
27. Mexico	..	2	..	..
28. Sydney	..	..	..	203
29. Geneva	..	..	15	..
30. Gronigen	34	..	..	..
31. Washington	5	..	..	..
32. Michigan	47	..	..	..
Total ..	7,129	5,877	2,886	1,199

APPENDIX V

INSTITUTIONS AND PRIVATE COLLECTORS FROM WHOM PLANTS AND SEEDS WERE RECEIVED IN 1958

Australia	The Parks Department, Brisbane; The Botanic Gardens, Brisbane; The Government Botanist, South Yarra, Victoria; The Botanic Gardens, Canberra.
Bahamas	A. C. Langlois, Nassau.
Belgium	City Botanic Gardens, Louvain, Botanic Gardens, Antwerp.
Bermuda	Department of Agriculture.
Ceylon	Dr. E. Soysa, Colombo.
Czechoslovakia ..	Institutum Naturae-Scienecum, Prague.
Denmark	University Botanic Gardens, Copenhagen.
Federation of Malaya ..	Botanic Gardens, Penang; Mr. Chew Tze Foong, Kuala Lumpur.
France	Botanic Gardens of the Faculty of Sciences, Besancon and of Strasbourg.
Germany	Botanic Gardens:—Munich; Cologne; Gottingen University; Berlin; Friedrich Schiller University, Jena; Essen; Halle; Frankfurt (Palmengarten); Johannes Gutenburg University, Mainz; Darmstaadt, M/s. Robert Blossfeld, Lubeck.
Ghana	University College, Achimota.
Hawaii	Foster Botanic Gardens, Honolulu.
Holland	Botanic Gardens, Leiden.
Hongkong ..	City Parks Department, Mr. Peter Tsang, Kowloon.
Hungary	University Botanic Gardens, Szeged; M.T.A. Botanikai Kutato Intezete, Vacratot; Botanic Gardens, University of Budapest.
India	Forest Research Institute, Dehra Dun.
Indonesia	Dr. Meijer, Sumatra.
Italy	Botanic Gardens of the Universities of Catania, Sicily and Modena.
Japan	University Botanic Gardens, Osaka; Mr. T. Satake, Hiroshima-ken; Mr. Shigeo Kurata, Tokyo; Botanic Gardens, Osaka; H. Suenaga, Kagoshima; Yosihumi Oka, Matsuzaka.
Kenya	Parks Department; Nairobi.
New Guinea ..	Mr. F. R. McKillop, Rabaul; Forest Department, Lae.
New Zealand ..	Anderson & Son Ltd., Napier.
Poland	Institutum Plantarum Medicinalium, Poznan.
Portugal	Botany Department of the University of Lisbon.
Siam	Mrs. Karnusut, Bangkok.
Singapore	Singapore Gardening Society; Mr. Philip Liau, Nam Kee Nursery, Department of Botany, University of Malaya; Mr. Tan Chye Siam, Mr. Loke Wan Tho; Messrs. T. M. A. Ltd., City Council Nursery; The Hon. Mr. A. J. Braga.
South Africa ..	Department of Botany, University of Pretoria.
Sweden	Botanic Gardens of the University, Upsala.
Switzerland ..	Botanic Gardens of the University of Basle.
Uganda	Botanic Gardens, Entebbe.
United Kingdom ..	Royal Botanic Garden, Edinburgh; Botanical Supply Unit, University of London; University Botanic Garden, St. Andrews; Carters Ltd., London, The Botanic Gardens, Glasgow.
United States of America	N. J. de Leon, Miami; E. A. Menninger, Stuart Florida; U. S. Plant Introduction Gardens, Florida; D. Barry, Los Angeles; Botanical Gardens, University of California; R. H. Gast, Los Angeles.
Venezuela	Dr. Leon Croizat, Caracas.
Yugoslavia ..	Botanic Gardens, Zagreb.

APPENDIX VI

INSTITUTIONS AND PRIVATE COLLECTORS TO WHOM PLANTS AND SEEDS WERE SENT IN 1958

Australia	Mrs. D. Wright, Queensland; Mrs. W. N. Cobley, West Australia.
Bahamas	Mr. A. Langlois, Nassau.
Bermuda	Department of Agriculture.
Brazil	Jardin Botanico, Rio de Janeiro; Hortus Botanico, Para; Instituto de Treinamento-Agronomico, Monte D'Este Lampinas.
Czechoslovakia ..	Kaul Zartos, Flostovince, Krasna Flora, Mad/Vltavon; Institute of Yang-Natural Philosopherin Pragneg Vysocany; Botanic Gardens of Academy of Science, Kosice; Davidik Vaclav, Krasna Flora, Mad/Vltavon; Monsieur de Directeur, Moravska-Museum V Brne, Brno.
Denmark	The Zoological Museum of the University of Copenhagen.
Egypt	Mr. A. Birch, Middle Egypt Botanic Station, El-Saft.
Federation of Malaya ..	Forest Department, Kuala Lumpur; Conservator of Forest, Johore Department of Agriculture, Kuala Lumpur.
Fiji	Major Willoughby-Tottenham, Suva; The Conservator of Forest Department of Forestry, Suva.
Finland	Botanic Gardens of the University of Turku.
Formosa	Botanic Gardens, Taipeh, Taiwan.
France	Office of the Mayor of Lille; Director, Botaniques La Leonina-Station Expt., La Beaulieu S/Mer (A.M.).
Germany	Arznaipflanzen Kulturen, veb. Homoopharm, Leipzig 05; Bernadus Vien Saase, Aalen/Wurttenberg; Curator Herbarium, Botanischer-Gartens, Hamburg 36.
Ghana	College of Technology, Kumasi; Department of Agriculture.
Hawaii	Makiki Nursery, Honolulu.
Holland	Hortus Botanicus, Leiden.
Hungary	Botanikai Kutata Intezete, Vacratot.
India	Botany Branch, Forest Research Institute, Dehra Dun; The Horticulturist, Department of Agriculture, Hyderabad; S. Hedayatullah, Bungalow No. 4, Agriculture Farm, P.O. Tejaon, Dacca; The Director, National Botanical Gardens, Lucknow; A. Percy Lancaster, Directorate of Horticulture, Central P.W.D., New Delhi.
Iraq	Dr. Matti Al-Aish, Department of Botany, Baghdad.
Italy	Mr. C. Sherrill, Taorenina, Sicily.
Japan	Mr. T. Satake, Satake Engineering Co., Ltd., Tokyo; The Botanical Garden of Osaka City University; S. Kurata, 22015 Motoki-cho, Adachi-ku, Tokyo; Kasutabe Expt. Station of Medicinal Plants, Kasutabe-shi, Saitawaken; V. Segawa, Kosobe, Osaka Prefecture; Izu Experimental Station of Medicinal Plants, Shizoukuken; Mr. Yosihumi Oka, 1877 Nakamachi Matsuzaka, Mie; Onomichi Botanical Gardens, Hiroshima-ken; Miyakejima Weather Station, Tokyo.
Jamaica	Mr. V. James, Royal Botanic Gardens, Kingston.
Kenya	Mr. H. P. Greensmith, Parks Superintendent, City Hall, Nairobi.
Marianna Islands ..	Director of Agriculture, Trust Territory of the Pacific, Agama, Guam.
Mexico	Senor Carlos Prieto, Balderas 68 Mexico D.F.; Boone Hallberg, Domicilio Conocido, Ville Atla, Oaxca.
New Guinea ..	F. R. McKillop, Arawa Plantation, Rabaul; R. E. D. Dwyer, Department of Agriculture, Stock and Fisheries, Port Moresby; P. Bateson, Education Department, Port Moresby.

New Zealand ..	J. N. Anderson & Son, Ltd., Plant Growers—Nurserymen, Napier; Director Parks and Reserve, Parks Department, City of Auckland; W. L. Home-Morrison, 127 Pt. England Road, Auckland; Mr. Gray Jamieson, 89 Latham St. Napier.
Nigeria	College of Technology, Nigeria.
North Borneo ..	Conservator of Forests, Sandakan.
Puerto Rico ..	Agronomist, Federal Expt. Station, Puerto Rico.
South Africa ..	Dr. P. R. Enslim, N.C.R.L., Box 395, Pretoria; The University of Pretoria.
Switzerland ..	Samin-Manser, P.O. Box Zurich 22.
Thailand	V. Jirawongse, School of Pharmacy, Bangkok.
Trinidad	Imperial College of Tropical Agriculture.
United Kingdom ..	The Curator, Glasgow Botanic Gardens, Glasgow; Major V. F. Howell, Cobham, Surrey; E. J. H. Corner, Botany School, Cambridge; The Director, Royal Botanic Gardens, Kew, Surrey.
United States of America	Mr. Barry, California Jungle Gardens, Los Angeles, California; David S. Fox, Little Rock, Arkansas; Mr. L. C. Knorr, Citru-Experimental Station, University of Florida; Plant Introduction Section, U. S. Department of Agriculture, Beltsville, Maryland; Mr. Edwin Menninger, Stuart, Florida; Mr. Harrison Yocum, The University of Tennessee, Tennessee; Albert Rolleri, California Evergreen Nurseries, San Francisco; Department of Botany, University of North Carolina; N. J. de Leon, Miami, Florida.
Vietnam	Huyul Van-Tung, Jardin Botanique, Saigon.
Venezuela	Dr. Leon Croizat, Caracas.
Yugoslavia ..	Hortus Botanicus, Zagreb.

APPENDIX VII

COLONY OF SINGAPORE GOVERNMENT *GAZETTE*
Supplement No. 52, Friday, August 15, 1958.

No. S 182—THE BOTANIC GARDENS ORDINANCE, 1957.
(No. 32 OF 1957).

THE BOTANIC GARDENS RULES 1958.

In exercise of the powers conferred by subsection (1) of section 4 of the Botanic Gardens Ordinance, 1957, the Chief Secretary hereby makes the following Rules:—

Short title.

1. These Rules may be cited as the Botanic Gardens Rules, 1958.

Definition.

2. In these Rules "vehicle" means any vehicle whether mechanically propelled or otherwise.

Hours of opening.

3. The Gardens shall be open daily from 6 a.m. to 7 p.m.: Provided that the Director may open or close the Gardens or part thereof at any other times as he deems fit.

Restriction of entry into and use of Gardens by vehicles.

4.—(1) No vehicle other than private motorcars and bicycles shall be admitted into the Gardens except with the permission of the Director.

(2) No vehicle shall enter the Gardens except by the authorised gate or gates.

(3) No vehicle shall be driven or ridden within the Gardens except on such roads as are indicated by traffic or other signs to be open for use by vehicles and at a speed not greater than fifteen miles per hour: Provided that invalid chairs and perambulators may be permitted to be used on any other road or footpath in any part of the Gardens open to the public.

(4) No vehicle shall be parked in the Gardens except on the left hand side of the roads open to vehicular traffic and in accordance with the parking signs provided therefor.

Admission.

5. No person shall enter the Gardens except by the authorized gate or gates or remain in the Gardens except during the hours when the Gardens are open.

Protection of flora.

6. No person in the Gardens shall without the authority or written permission to the Director—

(*a*) climb any tree or bush;
(*b*) remove or injure any plant or part thereof;
(*c*) pick flowers;
(*d*) take any seed or cuttings;
(*e*) trample on any flower bed; or
(*f*) do any other act which causes injury to the flora.

Protection of fauna.

7. No person in the Gardens shall without the authority or written permission of the Director—

(*a*) fish in the lakes, ponds or streams;
(*b*) kill, hunt, shoot or trap any animal;
(*c*) collect any bird's egg or nest; or
(*d*) do any act which causes injury to the fauna.

Other prohibitions and restrictions on use of Gardens.

8. No person in the Gardens shall without the authority or written permission of the Director—

(*a*) bathe in the lakes, ponds, streams or water tanks;
(*b*) kindle any fire;
(*c*) expose for sale or sell any merchandise, food or drink;
(*d*) ply for hire, solicit, gamble or assist in gambling;
(*e*) have with him any animal, except a dog which shall be under proper control and on a lead;
(*f*) release any animal;
(*g*) throw or discharge any stone or missile;
(*h*) throw or deposit any filth, rubbish or refuse;
(*i*) throw or deposit any litter otherwise than in the receptacles provided therefor;

(*j*) discharge any fireworks, crackers, firearm or weapon;

(*k*) play any ball or team games;

(*l*) play any musical instrument or use any apparatus for the reproduction of sound by means of a loudspeaker;

(*m*) remove, damage, displace, deface or make improper use of any seat, shelter, structure, notice, label, appliance or utensil;

(*n*) affix or post any bill, placard, notice or advertisement to any wall, tree, fence or structure;

(*o*) erect or assemble any tent, booth, table or other structure;

(*p*) expectorate, use any indecent or offensive language, behave in an indecent or offensive manner or obstruct, disturb or annoy any other person in the proper use of the Gardens or loiter or obstruct any officer of the Gardens in the execution of his duty; or

(*q*) preach or deliver any public address or assemble for the purpose of holding or taking part in any religious or political meeting.

Contravention of Rules.

9. Any person who behaves in a disorderly or improper manner or contravenes the provisions of any of these Rules may be ordered out of the Gardens and be refused admission thereto subsequently by a police officer or an officer of the Gardens.

Penalty.

10. Any person who contravenes the provisions of rule 4, 5, 6, 7 or 8 of these Rules shall be guilty of an offence and shall on conviction be liable to a fine not exceeding one thousand dollars.

Made this 15th day of August, 1958.

E. B. DAVID,
Chief Secretary,
Colony of Singapore.

[No. 14052/50].